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PHILOSOPHY BY WAY OF THE SCIENCES

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PHILOSOPHY BY WAY OF THE SCIENCES

AN INTRODUCTORY TEXTBOOK

BY

RAY H. DOTTERER, PH.D.

PROFESSOR OF PSYCHOLOGY IN FRANKLIN AND MARSHALL COLLEGE

New York

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1929

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TO

MY STUDENTS IN PHILOSOPHY

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PREFACE

This book is based upon the assumption that the method of philosophy is in principle the same as that of the special sciences. Like them it should use the method of hypotheses, and give serious consideration only to such doctrines or positions as have implications which can be put to the test of conformity or nonconformity with verified fact. In one respect, to be sure, philosophy differs from the sciences: it must begin where they leave off. Its facts are their accredited achievements.

If this principle be accepted, it follows that some knowledge of the results achieved in the several fields of scientific research is prerequisite to any serious attempt to wrestle with the problems of philosophy. This is my *apologia* for preparing a "survey of the sciences." It may, indeed, seem presumptuous in this day of the division and minute subdivision of scientific inquiry for any one mind to try to cover the entire field of possible knowledge in the manner attempted here; and it must be conceded that the enterprise involves a considerable amount of risk. But it is a risk which must be run, if one wishes to philosophize. For philosophy must assuredly be more than an assemblage of bizarre speculations or even of beautiful and exhilarating poetic insights; it must be more, too, than an exegesis—however minute and painstaking—of philosophic masterpieces produced in simpler, not to say more ignorant times. Even in this era of specialized research it must insist upon being, as it has always been in its greatest representatives, a resolute attempt to think responsibly about the things that are.

Much of my material was used for several years in an introductory course given at the Pennsylvania State College, and considerable portions were presented in the summer just past

to classes in the summer school of the Johns Hopkins University. While the book is thus an outgrowth of classroom experience and is intended primarily as a textbook for beginners, I venture to hope that it will be of interest to the "general reader" as well as to the "student." For philosophy is the affair, not simply of the cloistered recluse, but of everyone who wishes to understand, to control, and to adjust himself to, the real world.

Nevertheless the reader who is neither a teacher nor a "student" will, I trust, pardon a few words in regard to the use of the book in the classroom. The order of topics is one which I have found helpful in my own work. The more abstract and general inquiries which constitute philosophy as ordinarily understood, may best be approached, it seems to me, by way of an account of the relatively concrete and particular problems of the sciences. Instructors, however, who do not wish to spend so much time on the special sciences may find it desirable to regard Chapters II, IV, and VI as collateral reading, and to concentrate at once upon the topics which have been presented as "perplexities." Or they can begin with Part II, which deals with what we have come to think of as in a peculiar sense problems of philosophy; and by the aid of the index and the cross-references work back to the more specific topics of Part I.

I must confess a certain degree of embarrassment in the matter of avowals of indebtedness. Proceeding on the assumption that we are all co-workers in the quest of truth, I have laid hold of bits of knowledge wherever I have been able to find them; and, my book-keeping having been woefully inadequate, it is no longer possible in all cases to say which came from whom. To a certain extent the references found in the footnotes or at the end of the several chapters will indicate the sources upon which I have depended. Specific acknowledgment should be made, however, to Professor Howard C. Warren and the Houghton Mifflin Company for permission to use the material reprinted on pages 221ff. I wish also to thank the readers and other representatives of the Macmillan Company for their help-

ful criticisms and suggestions in regard to both the general plan of the work and the treatment of specific topics.

But to make specific acknowledgments of indebtedness to all from whom I have received help would manifestly be out of the question. For, especially in preparing my "survey of the sciences" I have drawn from a multitude of sources, and have become indebted, directly or indirectly, to an uncounted host of original workers in the field of science. My own training has not been such as to qualify me to speak with "authority" in any of these special fields, and I wish to express my gratitude for assistance in reading and checking portions of the manuscript to Dean Gerald L. Wendt and Professor J. E. DeCamp of the Pennsylvania State College; to Professor Asa A. Schaeffer of the University of Kansas; to Dr. Paul R. Heyl of the Bureau of Standards, Washington, D. C.; and to Professors H. Justin Roddy, William F. Long, and Rollin L. Charles, my colleagues in the faculty of Franklin and Marshall College. It is not my intention, however, to shield myself behind the authority of these kind friends. Such errors and infelicities of statement as remain in this survey, as well as in the latter part of the volume, are of course mine and mine alone.

RAY H. DOTTERER

LANCASTER, PA.
SEPT. 6., 1929

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PART ONE

A SURVEY OF THE SCIENCES

PHILOSOPHY BY WAY OF THE SCIENCES

CHAPTER I

PHILOSOPHY AND THE SCIENCES

The Science of Things in General.—It is usually a little difficult to give the beginner in the study of philosophy a clear idea of what he is to do or to seek. He is perfectly clear, or thinks he is, about the subject-matter of the *sciences* which are included in his course of study. Botany is about plants; geology is about the rocks; astronomy is about the stars; psychology is about "the mind."[1] But what is *philosophy?* What is it about? Perhaps the best preliminary answer is to say that philosophy is not about anything in particular; but that it is about *everything.* Like the hero of Carlyle's *Sartor Resartus,* the teacher of philosophy is a "professor of things in general."

To express the idea a little more technically, the first mark of philosophy, in distinction from any one of the sciences, is its universality, its *comprehensiveness.* It attempts to cover the entire field of possible knowledge. Thus anything at all may be studied philosophically; and if anything is studied philosophically, it is studied, so far as possible, in relation to everything else, and to the whole. As Plato put it long ago, the philosopher is one who seeks to gain a "synoptic vision" of all that is. In plain Anglo-Saxon, the philosopher wishes to see all things together; or, still better, he wishes to see all things in-their-togetherness.

The Love of Wisdom.—If the first mark of philosophy is its comprehensiveness, the second is its disinterestedness. We said a moment ago that anything at all may be studied philosophically. And here we should add the further point that to

[1] Cf. Patrick, G. T. W., *Introduction to Philosophy,* 1924, p. 1.

be studied philosophically, it must be studied for the pure love of knowledge, and not for the sake of practical advantage. Thus a graduate student who is a candidate for the degree of Doctor of Philosophy may major in chemistry or physics or any of the so-called special sciences. For philosophy is the universal science, of which all the special sciences may be said to be the offspring. Philosophy is not characterized, then, by any peculiarity or limitation in its subject-matter, but rather by the attitude which it takes toward its subject-matter; and its attitude, if the phrase may be permitted, is that of *a disinterested interest* in truth.

Etymology is not always a safe guide to the meaning of words,—as witness our contemporary use of the word *atom*. In many cases, words have changed their meaning, or they have acquired a secondary or derivative meaning which in common usage has superseded the one suggested by etymology. The word philosophy, however, retains its original meaning. It is interesting to note that the first part of the word, the syllable *phil,* has the same meaning as in Philadelphia, anglophil, philanthropy, philharmonic, etc.; while the latter part of the word is found in sophomore, theosophy, sophisticated, etc. The word philosophy is thus seen to be derived from two Greek words, *philia* and *sophia,* the former meaning "love" and the latter "wisdom." Philosophy is accordingly the love of wisdom, or the wisdom which is loved. And, since knowledge is an essential part of wisdom, philosophy is also the love of knowledge, and may be said to include the entire body of knowledge, or possible knowledge, which is loved and ardently desired by the philosopher.

Pure and Applied Science.—Philosophy as the disinterested pursuit of truth is thus identical, except for its insistence upon the synoptic point of view, with what is known as "pure science." Science which is not *pure* is said to be *applied*. It would be misleading, however, to go through the list of the sciences and to describe this one as "pure" and that one as "applied." For, as we have already suggested, the distinction is

not one of subject-matter, but of the purpose or attitude of the inquirer. The same science, the very same subject-matter, may be studied as "pure science" by one student and as "applied science" by another. Thus a person who studies chemistry in order to learn to cook or to mix fertilizers is studying chemistry as an applied science; while a person who studies chemistry for its own sake, that is to say, as a branch of philosophy, is studying it as a pure science.

While it is true that, to some extent, applied science has grown directly out of the practical activities of life—as when a man consciously sets out to discover a law of nature in order that he may apply it—it is obvious that, for the most part, applied science presupposes pure science; and in this day of emphasis upon the "practical" bearings of education, it is important to remember that the founders of all the sciences, the pioneers in virtually all of the more fruitful lines of investigation, were primarily interested in knowledge for its own sake rather than for the sake of its practical applications—however valuable and important these have subsequently turned out to be. Thus when Galvani began to experiment with frogs' legs, he had no foreknowledge of electric lights and trolley cars; he was simply curious to discover the rationale of certain strange phenomena. Even today the really fruitful workers in experimental science are the men who have retained the spirit of pure research. And to destroy pure science—or, in our preoccupation with the application of truths already discovered, to starve and neglect it—would be to kill the goose that lays the golden eggs.

The Practical Value of Philosophy.—Philosophy, as the disinterested pursuit of truth about reality in general, shares the fine contempt of pure science for all that savors of immediate utility or advantage. It is not in any sense a vocational subject (unless for the few adventurous spirits who look forward to teaching it). Perhaps we should include philosophy among the luxuries rather than the necessities of life. If philosophy is a luxury, however, it is a luxury in the same sense

in which art, music, poetry, etc., may be classed as luxuries. For, like these, it is an element of the higher life. It may not help one to make a living; but it will help to make a life. Indeed, there is no satisfaction which is safer or more lasting than that afforded by pure science and philosophy. And, if the "practical man" wishes to have old-age insurance, if he wishes to safeguard himself against that time which is sure to come in the latter half of life, when the pleasures of youth will pall, he will fit himself for the more permanent satisfactions of philosophy.

In addition to the value of philosophy on account of the satisfaction which it promises to the individual, it has a social value which may also be fairly called practical. Our social adjustments depend very largely upon the attainment of a measure of agreement in regard to certain fundamental ideas. It is no longer possible—if it ever was—to reach this agreement by compulsion or by any appeal to authority. The difficulty is, however, that when we discuss controverted questions of theology, politics, and economics, there is commonly so much passion and excitement that the pursuit of truth tends to be forgotten. Instead of asking "Which is right?" we only too often find ourselves asking "Who is right?" And in all such discussions, as the old saying well expresses it, we tend to generate too little light and too much heat. The topics of philosophical discussion, on the other hand, are usually more remote, and do not touch us so closely as do the questions discussed by the social sciences. Consequently, in philosophical discussion, we are likely to come a little nearer to the ideal of calm, dispassionate inquiry; and we may then hope to carry over into our consideration of the more emotionally disturbing problems of economics, politics, and religion some measure, at least, of the attitude rightly called *philosophic*.

The Difference between Philosophy and Science.—As we have seen, philosophy differs from applied science and agrees with pure science, in the fact that its search for truth is disinterested. In its other characteristic of comprehensiveness,

it differs not only from applied but also from pure science, as the term "science" is usually understood. For when we speak of "science," we are usually thinking of some one of the "special sciences," of some particular subdivision of the field of possible knowledge; while philosophy, as we have seen, concerns itself with the entire field. Historically, all of the special sciences grew out of philosophy; and there is a sense in which all remain even now but branches of the mother science from which they have come.

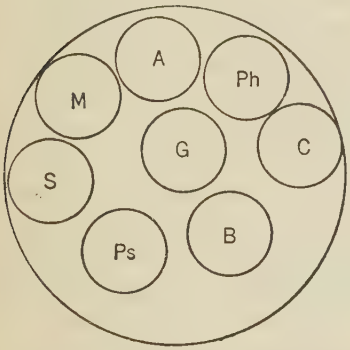

FIG. 1. The Entire Circle Represents Philosophy. M is Mathematics; A, Astronomy; G, Geology; Ph, Physics; C, Chemistry; B, Biology; Ps, Psychology; and S, Sociology.

The first to become independent of philosophy was mathematics. Then followed, somewhat in the order in which they are named, astronomy, physics, chemistry, biology, psychology, sociology. Roughly speaking, this chronological order is also the order of dependence: each of the sciences depends much more upon those which precede it in our list than upon those which follow it. It is difficult, however, to find a place for geology in this "hierarchy of the sciences"; for it has many points of contact, not only with astronomy—of which, viewed in a wider perspective, it may rightly be regarded as a part —but also with biology and physics. The accompanying diagram must not be taken too seriously; but in a general way it represents the relation of the various sciences to philosophy.

The rise of the special sciences to an independent status has been an inevitable result of the limitation of the human mind.

When Francis Bacon (1561-1626) was a youth, it was still possible for him to say, without undue arrogance, that he had "taken all knowledge for his province." For at that time the amount of scientifically verified knowledge was in reality very small. Such, however, has been the progress of scientific discovery and research in the last few centuries that, whatever may have been true in Bacon's day, it is no longer possible for any one head "to hold it all"; and one who should attempt to master the details of all the sciences would be foolish indeed. The philosopher, however, still maintains his ancient prerogative of busying himself with the entire field of possible knowledge. While he cannot master the details of all knowledge, he may hope to bring together into one grand synthesis the principal results of all the special fields of inquiry. He refuses to become a specialist,—unless, indeed, he may be considered a "specialist in generalities." For, as we have seen, it is of the very essence of philosophy to strive after the synoptic vision, to try, so far as is humanly possible, to view everything as a part of one all-embracing whole. It must be admitted that in this grandiose enterprise the philosopher is in danger of becoming a "jack at all trades and master of none"; but if he is not to be "disobedient to the heavenly vision," he must take the risk.

The Danger of Narrow Specialization.—The special scientist is likely to feel somewhat scornful of the philosopher's encyclopedic universality. In the interest of greater depth, the scientist deliberately restricts the width of his field of inquiry. And to one who believes it expedient to limit himself, it may be, to a subdivision of a subdivision of one of the special sciences, it naturally seems preposterous for a single mind to attempt to cover the entire field of possible knowledge. He feels that what is spread out so far must be pretty thin in most places.

It is important to bear in mind, however, that specialization has its own perils. The special scientist is like a dweller in a narrow valley surrounded by high mountains. If he is unable

to see beyond the mountains and unwilling to cross them, he will, to say the least, become somewhat provincial. Indeed, unless the specialist knows something of the great world of science which lies beyond the confines of his own specialty, he will not be able to understand even that. This the workers in the special sciences, especially in these latter days, are coming to recognize. Compelled by recent developments to overhaul the very foundations of the superstructure so laboriously erected during the last century, scientists are learning by sad experience that without the bird's-eye view—or should we now say, the aviator's perspective?—which is philosophy, it is impossible either to understand the fundamental concepts of any of the sciences, or rightly to apprehend the significance of the results of scientific research.

The Parable of the Wood-Chopper.—In practice, however, the philosopher, too, becomes willy-nilly a good deal of a specialist. While he concerns himself with the entire field of possible knowledge, he perforce accepts a division of labor in accordance with which each science is allowed to preëmpt so much of the field as it wishes to occupy, and philosophy then does such work as would otherwise remain undone. This work, which constitutes what may be called, in the narrower sense of the phrase, the field of philosophy, is the labor of criticism, integration, and orientation.

The division of labor which thus results between philosophy and the special sciences may be illustrated by a consideration of the behavior of a wood-chopper. Let us suppose that the wood has already been sawed into pieces of proper length (this supposition is no part of our parable), and that what remains to be done is to split it into pieces of the desired thickness. The wood-chopper falls to with his ax, and some of the pieces are found to be straight in the grain and to split very easily, while others are found to be gnarled and crooked and full of knots and to split, if at all, with great difficulty. Some of these the workman will hack at a few times, and throw aside for subsequent attention. After a while he will have, as a result of his

labor, several nicely ranked piles of split wood, and also a lot of knotty pieces.

Our parable scarcely requires interpretation. The nicely ranked piles of split wood are, of course, the special sciences; while the heap of knotty pieces, which have thus far resisted the wood-chopper's ax, is philosophy. For—tell it not to the physicists, the chemists, the astronomers, and the biologists, but it is true nevertheless—the special sciences are busied with the easier problems. At any rate, they are dealing with problems which can be properly stated, and some of which are in process of solution; while philosophy is dealing for the most part with problems which have thus far resisted solution, and some of which have not even been stated satisfactorily. It would not be far wrong to describe philosophy as the science of unsolved problems; and in our more pessimistic moments, we are tempted to say that it is the science which deals with insoluble problems.

But no! We shall call no problem insoluble until it has been definitely proved to be incapable of solution. And the proof that a problem is insoluble would, in a certain sense, be itself the solution of the problem. Accordingly, as long as a problem has not been shown to be insoluble, the philosopher assumes that it can be solved. For otherwise he would be a quitter, a deserter to the enemy in the agelong war against error and ignorance.

The Fivefold Task of Modern Philosophy.—One is tempted to suppose that with the rise and progress of the special sciences the work of the philosopher would become less and less. Upon second thought, however, it is obvious that the greater the number of the sciences, with their divisions and subdivisions, and the more rapid the progress of discovery, the more difficult, and also the more urgent, becomes the task of coördination and orientation. We may distinguish five elements in the task of modern philosophy:

(1) Philosophy *cultivates the unappropriated portions of the field* of possible knowledge. While the special sciences have re-

lieved philosophy of responsibility for the details of investigation over a large part of the field, there still remain, and in all probability always will remain, areas for which none of the special sciences acknowledge any responsibility. These must be cultivated by the mother science.

(2) Another element in the task of modern philosophy is to *examine the assumptions* made by the special sciences. It is perfectly right to make assumptions; but difficulties and misunderstandings arise if it then be forgotten that assumptions have been made. It is a part of the task of philosophy to drag these often unacknowledged first principles to the clear light of day in order that we may then be in a position to decide whether we really wish to grant them. For example, philosophy reminds us that all science is based upon the assumption that every event has a cause, and inquires whether and in what sense this ought to be conceded.

(3) In the third place, philosophy *analyzes the concepts* of the special sciences. Such ideas as *space, time, matter, motion, mind,* etc., are used, and rightly so, by many workers in science without any attempt at definition. Ask a geometer what he means by "space," ask a physicist what he means by "motion," and unless each of these is a philosopher as well as a man of science, he will probably reply that these are philosophical problems which he as mathematician or as physicist is under no obligation to consider. Ask a psychologist the same question about "mind," and he, as likely as not, will be ready with an answer; but the psychologist is usually a good deal of a philosopher. As a rule, the special sciences simply go ahead with their investigations as if everyone had a clear understanding of their fundamental concepts; and it is the duty of philosophy to seek to discover, if possible, just what these concepts really mean.

(4) We come next to the central task of philosophy, for which the examination and criticism of the assumptions and concepts of the sciences are indispensable preliminaries. The central task of philosophy is *to construct an all-inclusive world-*

view by weaving together the accredited results of all the sciences. When we speak of a "world-view," the reference is, of course, not simply to our planet, but to the entire universe, or sum-total of universes, if we may speak of more than one. And by universe, or sum-total of universes, we mean in philosophy, not only all material realities, but the sum-total of all existents, spiritual as well as material. By the accredited results of the sciences we mean such theories or hypotheses as are regarded as established by those who are experts in the field in question. Thus the philosopher is dependent upon the several sciences for the data out of which he seeks to construct his synoptic vision.

(5) Finally, after having learned what sort of universe it is in which we live, philosophy has the further task of orienting man in this world of the sciences. It must show him which is east; must help him to get his bearings. There is a sense, indeed, in which the sciences in their pursuit of truth must necessarily be cold-blooded and inhuman. They rightly seek to describe the world as it is, and not as we might prefer it to be. In scientific research it is highly important that the wish shall *not* be the father of the thought. Man, however, is not merely a truth-seeker; he is also a creature of hopes and fears, of approvals and disapprovals, of preferences and repugnancies. And, assuming that we have learned all that we can about the nature and structure of the universe, it is pertinent to inquire whether man can feel at home in this world, or whether he must construct a world of dreams and shadows in which to take refuge from stern, hard-faced reality. Thus philosophy culminates in a discussion of human *values,* of the relation of the real to the ideal.

World-View and Life-View.—We have been hinting at a distinction which ought to be emphasized. By a "world-view" we mean a matter-of-fact description of reality, an account *of that which is,*—an account which is warped just as little as possible by human preferences and desires. A "life-view," on the other hand, is a *plan,* a "blue-print," so to speak, of what

ought to be striven for, and may be striven for with some hope of success. It is important that the world-view should come first. For, just as it is unwise to make a plan for one's own day or week without a knowledge of the actual situation in which one finds himself, so it is impossible to construct a sound scheme of human living until a survey of reality has been made.

Suppose a man to go to his physician for a physical examination. He is in a somewhat paradoxical frame of mind. He wishes to hear good news, but he wishes even more to be told the truth; and, if he is wise, he does not desire that his wish for good news shall interfere with the rigorous efficiency of the examination. And woe to the examiner who allows the softness of his heart to affect the hardness of his head! If the examination is to serve its purpose, it must not be controlled by human wishes. Tender sympathy is a beautiful human attribute; but there are situations in which it is likely to become a hindrance to the attainment of human well-being. After the examination has been completed, a life-plan may then be made. The man makes his will; he lightens his load; or, perhaps, in view of a favorable report, he looks forward to a decade of strenuous activity.

Speculative Philosophy and Critical Philosophy.—In his book entitled *Scientific Thought,* Mr. C. D. Broad makes a distinction between two types of philosophy which he calls, respectively, "speculative philosophy" and "critical philosophy." The former corresponds to the last two elements of our fivefold task, while the latter corresponds to our second and third elements. Speculative philosophy is the attempt "to bring together the results of the various sciences with the results of the ethical and religious experience of the race and then to reflect upon the whole." Critical philosophy, on the other hand, is the examination of the fundamental ideas of the sciences.

It is obvious that critical philosophy would logically come first; for there can be no satisfactory understanding of the whole without a clear knowledge of the parts or elements which

constitute it. Psychologically, however, and historically, speculative philosophy comes first. A more or less vague idea of a whole usually precedes attempts at analysis. Thus we are sometimes able to recognize a face, even though we could not have told the color of the man's hair or eyes or even whether or not he had a moustache or wore glasses. It is then psychologically understandable that many centuries ago philosophers began to construct ambitious speculative systems; and that it was much later when the human mind entered upon the more arduous task of achieving a piecemeal conquest of the field.

We might wish, indeed, that system-making could wait until analysis has been completed; but, even apart from the consideration that analysis may in the nature of the case be incapable of completion, this seems to be psychologically impossible. For analysis is dull work; and, in order to maintain interest in philosophic thought, we need the steam which is generated by the discussion of rival systems. Thus in the history of thought we find an alternation between periods of system-building and periods of analysis and criticism.

The Traditional Subdivisions of Philosophy.—The search for a world-view is known technically as "metaphysics." The word means literally "after" or "beyond" physics. "Physics," however, must be taken in its very broadest meaning as the entire science of nature, thus including not only what we now know as physics, but also astronomy, geology, chemistry, biology, etc. Indeed, in this broad sense, "physics" must be understood to include psychology as well as these; for modern psychology, too, aspires to be a natural science. Metaphysics is then the attempt to dig more deeply, and to unify more widely than the special sciences have attempted to do. It is an inquiry concerning the ultimate nature and structure of all reality, spiritual as well as material. If, however, we identify metaphysics with the search for a satisfactory "world-view," we must, of course, remember that the "world" of which we are trying to obtain a "view" is not the earth, but the sum-total of all reality. Metaphysics is thus the core of philo-

sophical inquiry. It has been subdivided traditionally into "ontology" and "cosmology." And, while it is not possible to distinguish sharply between the problems which fall under each head, it is well to have at least a general idea of the meaning of these terms and of the corresponding adjectives *ontological* and *cosmological*. We may say, then, that *ontology* is the branch of philosophy which inquires concerning the *nature* of reality, while *cosmology* is the branch of philosophy which inquires concerning its order or *structure*.

In other words, ontology asks about the ultimate kind or kinds of reality which have to be recognized. Thus some philosophers have held that there are *two* ultimate kinds of substance, matter and mind. These are the dualists. Other philosophers, the monists, recognize but *one* kind of substance, of which they give accounts that are at least verbally different, the nature of the account depending upon whether a particular philosopher is a materialist, mentalist, neutralist, or what not. (It is obvious that the term "substance," as we have used it in the preceding sentences, must not be identified with material substance; for this would be a begging of the question. At least at the outstart of the ontological inquiry, we must define our terms in such a way as to admit the possibility of mental as well as of physical or material substance.)

Cosmology, as we have said, is an inquiry concerning the structure of reality. Here, again, etymology may help us. The Greek word *cosmos* means "world"; but it also connotes "beauty," as witness our familiar English word cosmetic. The Cosmos, or Kosmos, was then, in the thought of the Greeks, not simply the world as the sum-total of all things; but it was the beautiful world, the world as the assumed abode of order and harmony. It must be admitted that the term cosmos, thus understood, is a question-begging word; but whether or not the cosmologists of the past overemphasized the orderliness of the universe, the attempt to determine whether or not there is order in ultimate reality, and if so, how much and of what kind, is what is meant by cosmology.

Another important subdivision of philosophy is the theory of knowledge, or to call it by its long name, *epistemology*. After men have wrestled for a while with the problems of ontology and cosmology, they are likely to raise the question whether the human mind is competent to deal with inquiries of such transcendent difficulty and importance. Before we attempt to perform a given task, we ought to be sure that we possess an adequate instrument. In epistemology, then, we discuss the relation of reality to the human mind. We inquire about the source and validity of human knowledge. How do we obtain knowledge? And, assuming that we have it, does it correspond with reality?

It has sometimes been assumed, indeed, that epistemology is logically prior to any other inquiry whatsoever. And in support of this assumption, it has been urged that all science presupposes the possession of a science of knowledge. If we think more closely, however, we see that this cannot be admitted; for if there could be no science before there is a science of knowledge, it is obvious that there could be no science of knowledge either. Thus the argument for the indispensability of epistemology proves too much. Nevertheless it is well to have some acquaintance with the discussions of the epistemologists —if it be only in self-defense!

In addition to metaphysics and epistemology, philosophy includes a third branch of inquiry which is known as *axiology*. This is an inquiry concerning *values*. Or we may identify it with the fifth element in our fivefold task of philosophy, the attempt to gain a life-view. The axiological inquiries are sometimes called the "normative sciences"; and under this head are usually grouped logic, ethics, and æsthetics—the sciences, respectively, of the True, the Good, and the Beautiful.

Philosophy and the History of Philosophy.—One may approach the study of philosophy by attempting to gain a knowledge of the principal movements of thought from the time of the classic Greeks to the present. It is interesting to observe how the various schools of thought were influenced by the political and economic conditions of the time when they arose;

and how every great system has influenced those which have succeeded it. This method of approaching the study of philosophy was especially characteristic of the latter half of the nineteenth century. It seems to the present writer, however, that there are two very serious objections to the practice of beginning the study of philosophy with the history of philosophy.

In the first place, there is danger that the beginner will be bewildered by the succession of strange ideas, and that he will come to think of philosophy as nothing but a parade of bizarre doctrines and off-color points of view, which no sensible person is expected to take seriously.

In the second place, there is danger of falling into the error of identifying philosophy with its history, and of regarding philosophizing as merely a species of literary criticism. The student of philosophy thus becomes primarily an exegete who imagines that his work is done when by the aid of grammar and dictionary (supplemented by such biographical information as he has been able to amass) he has succeeded in determining the (probable) meaning of the most important passages in the masterpieces of philosophy.

If, however, the student can be made to realize that there is no historic system of philosophy to which the learner can simply attach himself, but that after the history of philosophy has been mastered and the labor of exegesis has been completed, the real work of philosophizing still remains to be done, then the study of the history of philosophy may be a valuable way of approach.

Philosophy and the Problems of Religion.—Many persons are led to the study of philosophy as a consequence of their interest in the problems of religion. The religious interest is much deeper and far more widespread than might at first be supposed. The topics which interest us most of all are the ones concerning which we are most disposed to be reticent; and the avoidance of certain topics in miscellaneous gatherings is not an indication of a lack of interest in them, but rather of the difficulty of controlling the emotions which they are

likely to evoke. When religious questions are broached in the classroom, they are found, as a rule, to arouse intense interest. It is therefore a helpful pedagogical device to show the analogy or, where it exists, the logical connection between theological issues and philosophical issues. Religious questions, however, stir most of us too profoundly for their discussion to be a wholly satisfactory introduction to the problems of philosophy. For the most part, it is better strategy to proceed in the other direction. Occasional allusions to the doctrines of traditional theology will help, indeed, to arouse and to maintain interest in the drier problems of philosophy; but in order to lead the student to adopt the genuinely philosophic attitude of calm, unbiased consideration, we need a subject-matter which is less stimulating to the emotions.

The Approach to Philosophy through a Survey of the Sciences.—In the chapters which are to follow we shall attempt to approach the problems of philosophy by way of a survey of the principal achievements and perplexities of the special sciences. If, as has been suggested, our life-view is logically subsequent to our world-view; and if this world-view is to be attained by weaving together and reflecting upon the results achieved by the sciences, it is important that the beginner in philosophy should be reasonably familiar with these results.

Answers to Objections.—It is not likely, however, that everyone will be willing to accept the point of view which we are about to adopt. In the first place, there are many sincere people who believe that science is on the wrong track. In particular, they hold, science has gone wrong in the matter of evolution. And, in general, these good people would condemn all conclusions of science which do not square with the letter of the biblical narratives. This is a question which we can discuss more intelligently when we come to consider the achievements of astronomy, geology, and biology. It may suffice to say here that it is too late in the course of human events to go back and adopt a biblical geography and a biblical astronomy,

as consistency would require us to do if we should insist upon the acceptance of a biblical biology. We cannot turn back the hands of the clock. The day of belief in the flat earth and in the rising and setting of the sun has gone by, never to return.

In the second place, there are many who consider themselves "Liberals" in theology, who accept the main conclusions of contemporary science, and are nevertheless reluctant to take all of these conclusions at their face value. They seem to feel that science is able, after all, to give us but a superficial and inadequate view of things; and they hope, by means of "faith" or "intuition" or some kind of mystic insight, to gain a more satisfactory apprehension of reality than science gives us.

It seems to me, however, that this appeal to intuition as over against reason cannot be allowed. It is, in effect, an attempt to introduce a kind of "extra-territoriality" into the realm of ideas; and, as a permanent arrangement, extra-territoriality does not promise to work any better in the realm of ideas than it has done in the realm of international relations. For, if intuition is to be substituted for reason as the final court of appeal, if firmness and sincerity of belief, rather than the strength of the evidence, be made the criterion of truth or falsity, what could anyone say against the claims of theosophy and table-turning, against transmigration of souls and polydemonism, against any sort of occultism and superstition whatsoever? It is only in my own case that I could possibly consent to make certainty of conviction a substitute for strength of evidence; I could not possibly grant this same principle to *you,* and you could not grant it to everyone else!

Moreover, the contrast between "reason" and "immediate insight" seems to be overdrawn. It is very doubtful whether any insight is really immediate. What comes to us, we know not how or whence, as what we therefore call intuition or mystic revelation, is in all probability the result of previous thinking which has left traces that now operate subconsciously. Furthermore reason, if rightly defined, is not opposed to but

rather presupposes insight. Reason, indeed, is simply the comparison and evaluation of insights. And to say that what comes to us as an "immediate insight" is therefore to be accepted without further question is equivalent to the exhortation that we should think with only a part of our mind. (See Chap. IX, pp. 263 ff.)

The Subdivisions of Our Survey.—In this book we shall proceed on the assumption (which may, of course, be erroneous) that the results arrived at by an honest, painstaking use of scientific methods are more likely to be true than views which come to us simply as the dicta of "authority"; and that the conclusions of intuition *and* reason are to be preferred to those vouched for by intuition alone. In the long run there can be no middle ground between science and superstition. Science is not a diabolical device for the destruction of the faithful; science, in its various departments, is but a method for the discovery of truth about the world and about man.

We remain loyal, therefore, to our purpose to approach the study of philosophy by way of a survey of the sciences. For this purpose we shall divide the sciences into three [2] groups:

1. Astronomy, Geology, and Physical Geography.
2. Physics, Chemistry, and Mathematics.
3. Biology and Psychology.

In the case of each group we shall first study the achievements, that is to say, the results which those who are expert in the fields in question regard as well established; and we shall then discuss the perplexities or problems which still remain for solution. It is only fair to say that, as students of philosophy, we shall be more interested in the perplexities than in the achievements. The beginner must not be permitted, however, to get the idea that philosophy is hostile to the sciences. It will therefore be good tactics to give due recognition to the solid foundation of verified results which have been achieved

[2] Some of the achievements and perplexities of the *social sciences* will be discussed under the headings, "The Real and the Ideal," and "The Belief in Progress." (See Chapters XIII and XIV.)

in each field before we proceed to point out defects and shortcomings.

In the course of our discussion of both achievements and perplexities, we shall find opportunity every now and then to direct the reader's attention to wider implications of the topic in question; and after the mind of the reader has thus been prepared, he will be ready to master the more conventional presentation of the problems of philosophy which he will find in the second half of the book.

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CHAPTER II

ASTRONOMY, GEOLOGY, AND PHYSICAL GEOGRAPHY—ACHIEVEMENTS

1. An Empirical Knowledge of the Succession of Day and Night, the Seasons, the Phases of the Moon, etc.

Primitive man probably thought of the events which we call "natural," so far as he thought of them at all, as more or less isolated occurrences. So far as he tried to account for them he regarded them as the capricious acts of personal beings like himself. Even primitive man, however, must have recognized the regular sequence of light and darkness every twenty-four hours; the phases of the moon—new moon, first quarter, full moon, last quarter—every month; and the orderly succession of the seasons—wet and dry, or warm and cold, depending on the part of the world—each year. Long, indeed, before men learned to divide the day into hours, or to formulate the numerical relationship of days to months and to years, they must have had some vague impression of order in the occurrence of phenomena such as these.

The Idea of Law.—Thus early man was probably never wholly without some idea of regular sequence. And out of this as a germinal principle has arisen our modern conception of the world as a realm of law. Before going on, however, to trace the gradual development of the idea of law in nature as it is illustrated by a survey of the history of astronomy, it is important that we should distinguish clearly between two senses of the term *law*. These are "natural law" and "civil law." The latter is no doubt the primary meaning. A law was first a command or an order issued by a ruler for the guidance of those who were subject to his authority. As members of fam-

ily groups, of clans, and of nations, men have been familiar from time immemorial with this sense of the term. And when it was found that external events occur in accordance with regular sequences, so that it is frequently possible to regard one event as the sign or cause of another, it was natural to carry over the idea of law from the realm of human relationships into this extra-human realm. It is, perhaps, unfortunate that the same term is thus used for two ideas which are essentially dissimilar. It is therefore very important that we should so far as possible avoid confusion and misunderstanding. If we may indulge in a play on words, while civil law is *pre*scriptive, natural law is merely *de*scriptive. An order, a command, a legislative enactment, a constitutional amendment may become, in a very real sense, a cause of events. A natural law, on the other hand, is in no sense a cause of phenomena; it is simply a statement of the sequence in which they occur. Thus, as we shall see more clearly a little farther on, it is highly misleading to say that material bodies attract each other because of the law of gravitation; for the law of gravitation is in essence but a statement of the fact that material bodies which are not held apart are always found to approach each other.

2. The Prediction of Eclipses

The "Saros."—While day and night, the seasons, and the phases of the moon must have been recognized from the earliest times as in some sense natural events, eclipses were long regarded as supernatural. Just as the thunderbolt was hurled by Zeus or by Thor, so an eclipse was a portent, an indication of divine displeasure. Naïve explanations were advanced by primitive people, as that a great monster was seeking to devour the orb of night or the orb of day, as the case might be; and, until quite recent times, in various parts of the world, kettles and pans and other varieties of kitchen artillery were beaten in order to frighten away the enemy. Of course, the hullabaloo always accomplished its purpose! Historians tell us that in the year 585 B.C. a battle was in progress between the Lydians

and the Medes, when an eclipse of the sun came on. Both sides must have had uneasy consciences, for as the eclipse approached totality and the weird darkness grew, fearing the displeasure of the gods, they became alarmed, quit fighting, and made a truce. The battle has accordingly been known as the "battle of the eclipse." As modern astronomers are able to calculate the dates of eclipses both forward and backward, this date, 585 B.C., has been accurately determined, and has been of considerable importance in fixing the chronology of ancient times.

Now this very eclipse of the sun had been predicted by a man named Thales, who is usually described as the father of philosophy among the Greeks. Just what sort of calculations he employed we do not know, but it is probable that he made use of a period of time known as the "saros." This was a period of about 18 years and 11 days, or of 223 lunations. (A lunation is a lunar month, the time required for the moon to pass from new to full and then to new again.) We know that a lunar eclipse occurs when the moon is in line with the earth and the sun in such a way that the shadow of the earth falls upon the moon. A solar eclipse, on the other hand, can occur only when the moon gets between the earth and the sun in such a way as to obscure a part or the whole of the sun's disk. In other words, eclipses of the moon can only occur at full moon, and eclipses of the sun at new moon. Now, without knowing just how or why eclipses are produced, the wise men of ancient times, probably long before the time of Thales, had discovered an empirical sequence. They kept careful records of the occurrence of eclipses, and found that after 223 lunar periods the eclipses would repeat themselves in the same order and at the same intervals.

The Concept of Nature.—Among the most ambiguous terms in our language are the words "nature" and "natural." We may discriminate natural, as opposed to artificial, from natural as opposed to supernatural. The two meanings have, however, the common element of taking place without interference on the part of a personal will. Nature is, accordingly, a realm

which is thought of as self-contained, as controlled by its own laws. If there were no connection among events, if the occurrence of one could never be safely regarded as a sign of the occurrence of another, nature, in our sense of the term, would be non-existent. The history of science is then a record of the continual enlargement of the domain of nature. In particular, the successive achievements of astronomy illustrate the gradual extension of the idea of law. We have discussed the significance of the prediction of eclipses. Certain other astronomical phenomena continued much longer to be regarded as more-than-natural. A notable case is that of comets. They were long regarded with superstitious alarm as inexplicable, unpredictable, unaccountable portents. But in modern times they, too, have been found to be law-conforming. Their return is predicted within a fair degree of accuracy, and educated people think of them as natural rather than supernatural phenomena.

Nature and the Supernatural.—Many of us have been accustomed to divide the world into two parts. One of these we call nature; the other we call the realm of the supernatural. To the former belong the events and processes of everyday life, the phenomena which science has shown to be law-conforming. To the latter belong the unusual, the miraculous, and the inexplicable. The distinction is, however, very questionable. For if by a supernatural event we mean an event which cannot be brought under law, an event which is therefore inexplicable, we may well question whether there are any supernatural events. Eclipses and comets, as we have seen, were formerly considered supernatural; but we should all agree to-day in saying that they are as much a part of nature as any other phenomenon whatsoever. A few generations ago most people would have said that the weather is supernaturally determined; now most people think of the weather as explicable in principle, although prediction is still somewhat uncertain.

Shall we say then that all so-called physical or material things are controlled by natural laws and produced by natural forces, but that psychic events and processes are more-than-

natural? The etymology of the word *physical* (from the Greek *phusis,* "nature") may seem to support the identification of nature with the physical; but words change their meaning, and etymology is an unsafe guide. The difficulty with the attempt to exclude psychical events from the realm of nature is that in the realm of mind, as well as in that of body, order and sequence have been discovered. So far, then, as mind is law-conforming, mind is also a part of nature. It may be said, to be sure, that mind has laws of its own, which are quite different from physical laws; but this is a begging of the question, for if we define nature as the domain of law, then mind, in so far as it is the arena of order, must be included within the natural realm.

Shall we say then that there is nothing supernatural, that all is natural? This is, it would seem, the inevitable outcome if we adhere to the traditional distinction between these terms. For if we define the supernatural as the inexplicable, we can never be sure that any given element of the "supernatural" will not, with the progress of science, be found to be natural. If, however, we give up the sharp distinction between the two ideas, we may think of the supernatural as a department *within* nature, rather than as an alien realm, beyond and above nature.

3. The Copernican Theory of the Solar System

In thinking of the progress of science, and particularly of the extension of the idea of law within the domain of astronomy, we must not imagine that the onward movement has always been continuous and in the right direction. In many cases, the human mind in its attempt to find a world of order made false starts, adopted hypotheses which later had to be given up. This was notably the case in attempting to describe the structure of the universe. At the beginning of the modern period two opposed theories contended for acceptance. According to the one theory, the Ptolemaic, which had been the accepted view for many centuries, the earth was regarded as the center of the universe. It was the main mass, and everything else existed for its sake and that of its inhabitants. According to the Coper-

nican theory, however, the sun is regarded as the center of our part of the universe, which we therefore call the "solar system"; and the earth is simply one of the planets, a relatively small body which nevertheless seems exceedingly important to us because it is *our* planet. The former theory, because it makes the earth the center, is known as the *geocentric* theory; while the Copernican theory, because it treats the sun as central, is said to be *heliocentric*. (In Greek, the words for "earth" and "sun" are, respectively, *ge* and *helios*.) We shall devote a disproportionate amount of attention to this achievement of astronomy, inasmuch as the replacement of the Ptolemaic by the Copernican view of the universe illustrates the principles upon which the sciences base their choice of hypotheses. It is important for the student of philosophy to inquire carefully into our reasons for preferring the heliocentric to the geocentric view, and also to realize the wider bearings of the issue, in particular the theological and social implications of the rival theories.

Principles Governing the Choice of Hypotheses.—In logic we learn that the only just ground for preferring one hypothesis to another is their relative success or non-success in accounting for the relevant facts. The hypothesis which most completely and most simply accounts for the facts which ought to be taken into account is chosen as the "true" theory. Tradition, authority, partizanship, æsthetic or emotional preference —all of these are excluded as reasons for our choice. What we should like to find true, what we ourselves may have said last week or last year—these have no bearing on the question whatsoever. All that we have a right to take into account is, I repeat, the success or non-success of the hypothesis in accounting for the facts.

The Superiority of the Copernican Hypothesis.—Why, then, do we prefer the hypothesis of Copernicus to that of Ptolemy? I suspect that this is usually an affair of authority and tradition. Before reading further I would suggest that the student write out his reasons for believing that the earth ro-

tates on its axis and that it revolves around the sun. I have found that most students too hastily assume that the motion of the earth is proved by the succession of light and darkness and of the seasons. A little more careful thought, however, will show that these facts could be explained about as well on the assumption that the sun revolves about the earth in a spiral path, rising a little farther north each morning from December to June and a little farther south each morning during the remainder of the year. These facts must, accordingly, be considered neutral as between the two hypotheses. There are, however, certain facts which are wholly without explanation on the hypothesis that the earth is stationary, but which are satisfactorily accounted for if we assume that the earth rotates on its axis. The bulging of the earth—not only of the continents but of the ocean-level as well—in the equatorial regions would result from the centrifugal tendency produced by rotation. As we shall see a little later, the explanation of tides and trade-winds depends upon the same assumption. Perhaps the clearest proof, however, is given by the famous pendulum experiment. If a very long pendulum is set swinging, the theory of the pendulum would lead us to expect that it would continue to swing in the same plane. But in our latitude, and still farther north, it is found upon trial to diverge hour by hour from the original plane of oscillation. The simplest explanation is that the pendulum really is swinging in about the same plane, as theory requires that it should, but that the earth is turning under it. Facts which can be explained more simply on the hypothesis that the earth is moving in a great orbit around the sun are the apparent retrograde motions of some of the planets in certain parts of their orbits, and changes in the relative position of certain of the constellations from one part of the year to a date six months later. Space forbids a fuller exposition of these points, and the student is referred to any good textbook on astronomy for their further elucidation.

Implications of the Copernican Astronomy.—The theory that the apparent motion of the sun, moon, and stars around

the earth is to be explained in terms of a real motion of the earth with reference to them is so familiar to us that its very familiarity tends to blind us to its significance. The substitution of the heliocentric for the geocentric view of the universe was a revolution of the greatest significance. First of all, let us think of some of its religious and theological implications. Back in the Middle Ages, when the geocentric theory was accepted, men had a very neat and "homey" view of the world. The earth was thought to be flat. Under the earth were Hell and Purgatory; in the region beyond the moon was Heaven. The stars were "heavenly bodies," differing radically from the earth, which was "terrestrial." All the heavenly bodies—sun, moon, and stars—revolved about the earth, and were subordinate to it. The vicissitudes of the human race were the chief concern of God, who had made all out of nothing, and had his throne beyond the sky. The whole universe existed for the sake of the earth, and therefore for the sake of man. This mediæval view of the world is clearly expressed in Dante's *Divine Comedy*. Guided by Virgil, Dante is permitted to witness the greater and lesser torments of the damned in Hell; in Purgatory he sees those who are being purified by suffering in anticipation of the joys of Heaven; and finally, his steps directed no longer by Virgil, but by Beatrice his beloved, he visits Heaven also. Now, of course, the *Inferno,* the *Purgatorio,* and the *Paradiso*—the three divisions of the poem—were not meant to be taken as literal descriptions of an actual journey. Yet, while they were fiction, they were fiction based on fact; or rather on what was supposed to be fact. The poem had its wonderful appeal because its general framework corresponded to the commonly received theory of the world.

With the adoption of the Copernican astronomy, this neat and simple view of the world was no longer possible. The earth, no longer conceived to be the main mass of the universe, for the sake of which all else exists, is but one planet among others. The earth, in fact, is but a rather small planet revolving about one of the smaller suns of the myriads scattered

throughout space. The view of the world which makes man and his fortunes the prime concern of the Powers of the universe becomes less plausible. Again, according to the new astronomy, there is no place for Hell and Purgatory. They cannot be under the earth; for *down* is no longer a fixed direction, but rather toward the center of the earth. In the same way, Heaven as a place beyond the sky cannot be accepted as sober geographical fact. Hell and Heaven are, then, not places; they may, perhaps, be thought of as conditions. And God, instead of being "transcendent," high above the world, enthroned in the heavens, comes to be regarded as "immanent"; that is to say, as dwelling in the world. This, at any rate, has been the direction in which modern theology has tended, as the implications of the new astronomy and of other scientific discoveries have percolated down into the thinking of larger and larger numbers of minds.

In other ways, too, the new astronomy has doubtless exercised an important and far-reaching influence. Mediæval thought was dualistic. Analogous to the dualism of earth and heaven, the sublunary and the superlunary regions, was the dualism of the sacred and the secular, the other-worldly and this-worldly, the ecclesiastical and the political, the cleric and the layman, the high-born and the low-born. The mediæval social order was completely determined by dualisms of this kind. Modern thought is characterized by a leveling tendency. This tendency toward democracy both in church and state is no doubt the product of many concurrent forces. But it seems clear that the analogy of the leveling of earth and heaven, as required by the new astronomy, has had some influence in producing the leveling of the high and the low in the social order.

4. The Law of Universal Gravitation

According to the new astronomy, the planets revolve around the sun with such velocities and with orbits of such size and shape as to produce the apparent motions which the various heavenly bodies have, as viewed from the earth. Kepler formulated the laws of planetary motions:

(a) The orbit of each planet is an ellipse, with the sun at the focus of the curve.

(b) The radius vector (*i.e.* the line connecting the planet with the sun) passes over equal areas in equal times.

(c) If the time required by any planet to complete a revolution in its orbit is called its "period," then the squares of the planetary periods are proportional to the cubes of their average distances from the sun.[1]

Kepler's laws, however, were simply empirical formulations. There was no reason for them. Each stood alone, logically independent of the others. It remained for Isaac Newton to formulate a more general law from which Kepler's laws may be deduced. Newton's law is the law of universal gravitation. It is, in brief, the assertion that all the planetary motions may be accounted for as the components of two forces or tendencies. One of these, the centrifugal, or center-fleeing force, results from the planet's tendency to keep on moving always in the same straight line. The other, the centripetal, or center-seeking force, may be thought of after the analogy of a bit of matter, as a stone or an apple, falling to the earth. The law of gravitation is, then, a generalization of the law of falling bodies. (See pp. 84 f.) It may be stated briefly, yet with sufficient precision as follows: Any two portions of matter "attract," *i.e.* tend to approach, each other with a force which varies directly as the product of their masses and inversely as the square of the distance between their centers. To make it a little more concrete, if the moon were twice and the earth four times as massive as they are, the attractive force operating between them would be eight times what it is. Again, since the moon is about sixty times as far from the center of the earth as New York City is, a pound weight would weigh as much on the sidewalks of New York as 3600 pounds at the distance of the moon (both being weighed with a spring balance).

Several other points must be taken into account in a full

[1] Moulton, F. R., *Introduction to Astronomy*, Revised Edition, p. 229. Cf. Crew, H., *General Physics*, Fourth Edition, p. 113.

statement of the law of gravitation. One is that the kind of matter makes no difference. The mass being the same, it makes no difference whether the matter in question be gold, or lead, or iron, or anything else. In order to appreciate the significance of this point we must bear in mind the distinction between mass and weight. Strictly speaking, mass is measured by the *inertia* of a body, that is to say, by the resistance which it offers to a change in its rate of motion; *weight* is the force with which the body is attracted by the earth. Since the objects with which we ordinarily have to do are all at approximately the same distance from the center of the earth, for all practical purposes mass and weight may be considered identical. Theoretically, however, the concepts must be distinguished. Another point to be mentioned is that the amount of gravitational attraction is not affected at all by intervening matter. In this respect gravity differs, for example, from magnetism.

There is reason to believe furthermore that the law of gravitation holds throughout the entire universe. Probably the most convincing proof is afforded by the existence of double and multiple stars far off in the heavens, which are found to revolve about a common center of gravity. Here, then, is one respect in which the universe is in the strictest sense a unity. There is no reason to believe that any time is required for the gravitational influence (if the phrase may be permitted) to travel from one part of space to another. Light has been found to travel at the rate of about 186,000 miles per second—a tremendous but yet a finite velocity. The velocity of gravitation would seem to be infinite.

5. The Measurement of Celestial Distances and Magnitudes

The distance from the earth to the moon is about 240,000 miles; that from the earth to the sun about 93,000,000 miles. How can these measurements be made? They depend upon a knowledge of the size of the earth. Consequently the first celestial magnitude with which we have to deal is the size of the

earth itself. We all know, of course, that the diameter of the earth is nearly 8,000 miles, and its circumference nearly 25,000. But how can the earth be measured? If all the books were burnt, and everybody had forgotten, how would you determine the size of the earth? We discuss this topic not merely for its own sake, but rather to gain an appreciation of the methods employed by our benefactors, the astronomers. Probably the simplest way to measure the earth is to measure a degree of latitude and then to multiply this result by 360, since there are 360 degrees in a circle.

Measuring a Degree of Latitude.—In practice latitude is usually determined by observing the sun. The navigator determines the position of the sun, and then by referring to his nautical almanac he is able to determine his own position on our planet. For the purposes of our discussion, however, it will be simpler to take the north star as the object of reference. At the north pole the north star would be seen almost directly overhead. It is obvious that at the equator it would be just on the horizon, and in the southern hemisphere it would be invisible. At the pole, then, the altitude of the north star, that is to say, its angular distance above the horizon, would be 90 degrees, and at the equator it would be zero. At twenty degrees north latitude the altitude of the star would be 20 degrees; at 40 it would be 40; and at 60, 60. And in general the altitude of the north star is the same as the latitude of the place from which it is observed. To determine a degree of latitude we might then observe the angular distance of the north star from the horizon, and walk due north until we came to a place where the star would be just one degree higher. Having thus marked off a degree, we could measure it with rod and chain. This distance multiplied by 360 would then, as we have said, give us the circumference of the earth. It has been found by actual measurement that a degree of latitude in high northerly regions is somewhat longer than in the equatorial regions. This is a proof of the flattening of the earth at the poles and of its bulging at the equator in con-

sequence of its rotation. Sea-level in the polar regions is less distant from the center of the earth than it is at the equator.

Determination of Other Sizes and Distances.—Having determined the size of the earth, it is possible to determine other celestial distances and sizes. The case of the moon may be taken as typical of that of all the members of our solar system. Suppose at two observatories, one of which is due north of the other, simultaneous measurements are made of the moon's altitude. Suppose further that we imagine a triangle to be drawn with one of its vertices at the center of the moon and the other vertices at the two observatories. The length of the line separating the observatories can be calculated; for we know their distance from each other in degrees of latitude. Thus one side of the triangle is given. The angles made by this side with the other sides can be inferred from the observations of the moon's altitude at each station when it crosses the meridian. Having now a side of the triangle and also the two adjacent angles, it is a matter of simple trigonometry to calculate the other sides. This will give the distance from each of our two observatories to the center of the moon, and it will then be easy to calculate the distance from the center of the moon to the center of the earth, which is the distance desired.

The same method may be employed in determining the distance of the sun. Unfortunately, in this case the angles to be observed are so small that no very accurate results can be obtained. An indirect method may, however, be employed. First, the distance of Mars or of one of the planetoids may be determined in the manner just described. Next, since the periods of the planets and planetoids have been found by long-continued observation, their relative distances from the sun and from each other may be calculated by means of the third of Kepler's laws. (See p. 31.) It is then a matter of elementary algebra to find the actual distance in miles of the earth and of each of the planets from the sun.

To determine the *size* of any member of the solar system, as

the sun or the moon, the astronomer first determines by accurate observation its diameter in minutes or seconds (′ or ″) of arc. Knowing the angular diameter, and also knowing the distance of the body from the earth, he can easily calculate the diameter in miles. Thus the sun's angular diameter is approximately 32 minutes of arc; its linear diameter is therefore about 900,000 miles, or about 110 times that of the earth. The moon's angular diameter is very nearly the same as that of the sun; but, as the moon is so much nearer to us, its linear diameter is found by calculation to be only 2,200 miles, or a little more than one-quarter of the earth's diameter.

The "fixed stars" are so far away that their angular diameters cannot be determined. Indeed, even in the most powerful telescopes they appear as mere points of light without observable dimension. The reason for this is, of course, not that they are really small (see p. 36), but that they are so very far away.

We have seen that in measuring the distance of the moon or of Mars from the earth, distances on the earth may be taken as base lines. In measuring the distance of a star it is possible to employ a baseline of 180,000,000 miles, which is in round numbers the diameter of the earth's orbit in its revolution around the sun. Most of the stars, however, are so far away that even with this tremendous base-line no "parallax" is observable. With the exception of our sun, which is also a star, the nearest of the stars are so far away that, although light travels at the rate of 186,000 miles per second, several years are required for the journey. Indeed, the *light-year,* that is to say, the distance traveled by light in one year, is the unit ordinarily employed in estimating stellar distances. Thus the distance of Alpha Centauri is said to be 4.4 light-years; that of Sirius, 8; of the north star, 44. Other stars are known to be so far away that the light by which we now see them has been on its way for thousands and even millions of years. Thus a star might have ceased to exist a hundred or a thousand years ago—and still be visible.

The size of many of the stars seems to be on the same tremendous scale as their distances. Professor Michelson has made some measurements by the use of apparatus based upon the principle of the interference of light. He has found, for example, that Betelgeuse, a star in the constellation Orion, has a diameter of over 300,000,000 miles. If the center of the sun could be placed at the center of Betelgeuse and the earth would remain at its present distance from the sun, the earth would be only a little more than halfway from the center to the circumference. Considerations such as these impress us with the staggering immensity of the universe, and the relative insignificance of our planet and of those who dwell upon it.

Measuring the Mass of the Earth.—Just as in measuring celestial distances and sizes we must begin with measurements of the earth, so in determining the mass of the other members of the solar system we must begin with a determination of the mass of our own planet. This has sometimes been called "weighing the earth," though for obvious reasons the expression is not accurate. Several methods have been employed.[2] One of these depends upon the deviation of plumb lines from the vertical under the attraction of a large mass, as, say, a mountain. From this we can determine the ratio between the gravitational influence of the mountain and that of the earth. The mountain is carefully measured and its mass estimated. Knowing the mass of the mountain and the ratio of its gravitational influence to that of the earth, it is then easy for the mathematician to calculate the mass or "weight" of the earth. Another method depends upon the principle of the torsion balance. By means of this device it is possible to determine quite accurately the force with which a pair of small lead balls which are attached to the balance are attracted by a pair of large stationary lead balls. The earth's attraction for the small balls is determined simply by weighing them. Knowing the ratio of these attractions, and being able to determine the mass of the large balls by weighing them, it is again a matter of calculation

[2] Moulton, F. R., *Introduction to Astronomy*, Revised Edition, pp. 48 f.

to find the "weight" of the earth. The result thus obtained is "six sextillion tons," or,

$$6 \times 10^{27} \text{ grams.}^{3}$$

Masses of Other Bodies.—The *ratio* of the masses of the other members of the solar system to that of the earth may be obtained by calculations based upon the velocity and orbits of the planets in their revolutions about the sun. Thus if the mass of the earth is taken as unity, that of the sun is about 330,000; the moon, $\frac{1}{81}$; Mercury, $\frac{1}{14}$; Venus, $\frac{4}{5}$; Mars, $\frac{1}{8}$; Jupiter, 300; Saturn, 90; Uranus, 13; Neptune, 17. We realize that astronomers give us, not simply guesses, but rather the results of observation and mathematical calculation. The masses of such stars as have been determined are found to be of the same order as that of our sun. Thus the combined mass of both components of the double star Algol is found to be about two-thirds of that of the sun. It is probable that some of the stars are much greater; but many which, like Betelgeuse, have a much greater volume have a correspondingly low *density*, so that the actual *mass* is not so much greater after all.

6. The Discovery that the Universe Is Homogeneous

In the Middle Ages, as we have remarked, men distinguished sharply between the earth and the heavens, between the sublunary and the superlunary regions. The modern astronomer, however, believes that in most respects, at least, the universe is homogeneous, *i.e.* of the same nature throughout. As we have seen, there is reason to believe that the law of gravitation holds true in the furthest recesses of space, as well as within our solar system. Moreover, scientists have discovered that the same chemical elements which make up our earth are found in the heavenly bodies.[4] That terrestrial elements are found in

[3] Cf. Crew, H., *General Physics*, Fourth Edition, p. 115.

[4] It is not impossible, of course, that elements no longer found in our earth—elements, it may be, with a greater atomic weight than that of uranium—are found in the stars. Even these, however, may be assumed to be composed of electrons and protons in no respect dissimilar to those which make up our planet. (See p. 111.)

celestial bodies is suggested by an examination of the constitution of meteorites or "aerolites," those mysterious bodies which have fallen out of the heavens. In ancient times such bodies were thought of as suitable objects of worship. Prosaic modern science, however, finds them to be composed chiefly of iron with smaller amounts of other well-known elements, as nickel, bismuth, silicon, magnesium, and some carbon.

Spectroscopic Revelations.—The most convincing evidence for the homogeneity of the matter which composes the stars with that found in the earth is produced by the spectroscope. The spectroscope is, in brief, a device by which the colors of a mixed light, like that, for example, of the sun, are dispersed in accordance with their wave-length. (See p. 90.) The light is admitted through a narrow slit and allowed to pass through a prism. In going through the prism, some wave-lengths are bent or refracted more than others. Consequently the colors are separated and spread out into bands somewhat like the colors of the rainbow. Now it has been discovered that each chemical element, when it becomes luminous, has a characteristic spectrum. For example, sodium is characterized by certain lines in the yellow part of the spectrum. In the same way, hydrogen, iron, etc., all have their characteristic lines or groups of lines. Accordingly, by the use of the spectroscope, it is possible, so to speak, to make a qualitative chemical analysis of the sun and also of far distant stars and nebulæ.

7. The Theory that the Stratified Rocks Were Laid Down in Water

In our attempt to gain a synoptic view of all reality, we now come back to our own planet. The science which treats in most philosophic fashion of the earth is *geology*. And the basic unifying concept introduced by geology is that of evolution. Most of the changes studied by astronomy are periodic; that is to say, after a longer or shorter time the same phase is repeated. In geology, on the other hand, we seem to be studying one-way processes. Whether these, too, are in the wider sense periodic

may be a matter for later consideration. Modern geologists maintain that the earth has become what it is, not by the operation of agencies which are in a peculiar sense supernatural, but through natural forces. Three sets of processes now in operation on the surface of the earth have given rise to most of its surface features. These are known as *diastrophism, vulcanism,* and *gradation*. The first includes all movements of the earth's crust, as portions of it rise or sink with respect to the sea-level. *Vulcanism,* of course, means volcanic action of every kind. *Gradation* includes all those processes—such as the action of winds and waters—which tend to bring the earth's surface features to a common level. Thus the continents have been raised and worn down again repeatedly in the course of geologic history, and the débris from the land has been thrown into the sea. As a result of various mechanical, chemical, and organic processes, this material has been cemented together to make the layers of rock. By later earth movements some of these layers, or *strata,* as they are called, have been raised to form new elevations, and the processes of erosion and sedimentation are begun anew. There is evidence that many miles of material have thus been raised from the sea, and much of it again transported to the sea. Many millions of years have thus been consumed—so many, in fact, that it is almost hopeless to correlate geologic time with time as counted by man.[5]

Creation and Evolution.—But, someone may object, how do we know that the earth was not made by the Creator a few thousand years ago, with the continents and oceans much as they are today, and with all the layers of rock in their places as we find them now except for such changes as have taken place since the time of creation? The only answer to such a question is to admit that we cannot know that such was not the case. On the other hand, there is no good reason for accepting such a hypothesis. It is as if someone should say of a tree, "It was created last week," and when it is cut down it should

[5] See Chamberlin and Salisbury, *College Geology,* 1909, p. 2. Cf. Brigham, A. P., *Geology,* Revised Edition, Part I.

be found to have a hundred rings in its wood, suggesting as many years of growth. Assuredly, the tree might have been created last week, with all the appearance of having grown for a hundred years; but no one believes this. There is no reason to believe that the Creator works arbitrarily. On the contrary, we have every reason to believe that trees and men and animals have come to be what they are by a process of growth. Now "evolution" is simply another name for growth. The strata of rock, like the rings of wood, are the evidences of growth. You may say, if you will, that God made the tree; but he made it by a process of growth. You may say, if you will, that God made the earth; but the process by which he made it is what we know as evolution.

8. The Discovery of the Significance of Fossils

"When sand, mud, etc., are deposited in the sea, shells of sea animals are frequently imbedded in them. If the shells or their forms are preserved, they make a record of the kinds of life that lived when the sediment was being deposited. If the sediment were deposited in lakes or on land, it is the shells or other relics of fresh-water or land life which are found in them. All such relics of past life are fossils." [6]

While in some places the layers have been tilted or even overturned, we usually have a right to assume that the sedimentary rocks which are found at or near the surface of the earth are more recent than those which lie underneath them. The lower and presumably older rocks are frequently exposed, however, as on hillsides where the more recent strata have been washed away, in the sides of canyons, or in mines and railroad cuts. In drilling wells for water, oil, or natural gas, much information has been obtained concerning the underlying strata. And in some drilling operations it has been possible to preserve a core of rock as a permanent record of the kinds of material passed through. Thus the geologist is able to arrange the various formations in approximately chronological order, and to assign the

[6] *Ibid.*, p. 36.

fossils found in them to their appropriate "era" and "period." Beginning with the most recent formations, and passing backward in order of time, but downward in order of position in the earth's crust, the eras as customarily named are the *Cenozoic,* the *Mesozoic,* the *Paleozoic,* the *Proterozoic,* and the *Archeozoic.* These words are Greek, and may be translated *recent life, middle life, ancient life, earlier life,* and *primitive life.* The names are significant as carrying back the vista of living things to earlier and still earlier times. Little can be said confidently of the length of these periods, except that they doubtless lasted for millions upon millions of years. "The duration of the Archeozoic era may exceed that of all subsequent time." The last era, the Cenozoic, is probably the shortest of all. This last era is subdivided into the following periods: the eocene, the miocene, the pliocene, the pleistocene, or glacial, and the human or present period. The human period is again probably the shortest of all. Inasmuch as the other eras are similarly subdivided, the student of geology, like the student of astronomy, is impressed with the insignificance of man. Perhaps, however, duration and magnitude are not the only, or the best, indices of importance!

9. The Theory of Glaciation

One of the discoveries of modern geology which will appeal most forcibly to the student of philosophy, because of its suggestion of the vicissitudes to which life is exposed on the earth, is the discovery of glacial periods. There have, no doubt, been many of these in the course of geologic history, and so far as the polar regions are concerned a glacial period may even now be said to be in progress. But the glacial period with which we are chiefly concerned, and which is usually called *the* glacial period, is the one which occupied the pleistocene, or the period just preceding that of man. In this period there were several invasions of the ice with times of milder climate between them. Some of these intervals were as long as the time which has elapsed since the last invasion. Indeed, for all we know to the

contrary, all human history as we are accustomed to think of it may occupy such an interval between the last ice age and an age of ice which is still to come.

Evidences of Glaciation.—Charles Darwin tells us that when a young man he accompanied a man named Sedgwick, an eminent geologist of the day, on a trip in search of fossils. The portion of country which they traversed is now known to bear very obvious traces of the effects of glaciation. But Sedgwick and the youthful Darwin saw none of these, because their attention was not directed to them. This experience illustrates the dependence of good observation upon the possession of some hypothesis which is to be either proved or disproved by the facts which are to be observed. One of the pioneers in the study of glaciers was Louis Agassiz. He had studied the glaciers of his native Switzerland, and had observed the polishing and scoring of the rock over which the ice moves, the "moraines" or mounds of drift left behind by the receding ice, the detached boulders carried long distances and set down in positions out of all relation to the surrounding strata, etc. Finding similar conditions in England and America, he advanced the almost unbelievable hypothesis that conditions had at one time prevailed in these regions which were comparable to those now prevailing in the Swiss mountains. This hypothesis has been abundantly confirmed by later investigators, and is to-day universally accepted.

The Area Covered by the Ice.—The ice sheets covered six or eight million square miles, in addition to those portions of the earth's surface which have remained under ice to the present day. More than half the glaciated area was in North America, and more than half of the remainder in Europe. Indeed, nearly half of North America was covered by ice. Continuous glaciation did not extend as far south on the mountain-girt plateaus of the Pacific border region as on the smooth, low plains of the Mississippi valley; for in general it was the plain, rather than the mountainous part, which had the most ice. The reason for this was that the ice was not formed *in situ* (that is, in the place

where it was subsequently found), but moved down from higher and more northerly regions, extending in great sheets to a distance in some directions of as much as 1500 to 1600 miles from the original centers of formation. The southern boundary of the ice-sheet passed through the northern part of Pennsylvania, and in the Mississippi valley came as far south as the mouth of the Ohio River. In the western mountains, local glaciers, not continuous with the ice-sheet to which we have just referred, were widely distributed, even as far south as New Mexico, Arizona, and southern California. South of the ice-sheets of Europe, great glaciers descended from the Alps to the lowlands in all directions. Even Corsica had glaciers. In Asia, glaciers larger than those of to-day affected all the higher mountains, and ice-sheets existed in some of the more northern lands. The southern hemisphere was also affected, though to a lesser degree, and Antarctica is assumed to have been buried beneath ice as now. In tropical regions, there were glaciers in mountains where none exist now, and in mountains where there are glaciers now, the ice then descended to levels 5,000 feet below its present limits.

The Cause of the Glacial Period.—Among the several hypotheses which have been advanced to explain the ice age, or rather the succession of ice ages, we may mention the following:

(a) There have been changes in the elevation of the continents.

(b) There have been changes in the axis of the earth.

(c) There have been changes in the ellipticity of the earth's orbit.

(d) There have been changes in the constitution of the atmosphere.

There is reason to believe that all of these have played their part. Thus it is well known that changes in elevation have occurred, and it is obvious in view of the effect of altitude upon climate that a marked rise in continental elevation would tend to produce the phenomena in question. It may be conjectured

also, in accordance with the principle of isostasy,[7] that the weight of the accumulated ice would tend in the course of thousands of years to depress the area which carried it so as to bring the reign of ice to a close; and that a series of elevations and depressions might thus take place, producing a succession of ice ages with milder eras between. There is some evidence also for the belief that what we now know as the polar regions may at one time have had a tropical climate, and it may be conjectured that on account of a shifting of our planet's axis of rotation portions of the earth's surface now included in the temperate zones, or even within the tropics, may have been the polar regions of long bygone ages. Again it can be shown that if the orbit of the earth were a little more or a little less elliptical than it is at present, there would be important differences in temperature.

The hypothesis, however, which many American geologists regard as giving the most plausible explanation of the alternation of glacial and interglacial epochs is that of changes in the constitution of the atmosphere.

One form of this general theory depends upon the fact that the presence in the atmosphere of great quantities of volcanic dust would act as a screen to prevent the radiation of the sun from reaching the surface of the ground. Periods of prolonged vulcanism, if the eruptions were of the explosive type, might then give rise to a long era of lowered temperature.

Another form of the theory builds upon the principle that the atmosphere serves as a blanket to keep the earth warm; and that the more carbon dioxide and water vapor this gaseous blanket contains, the better a blanket it is, and the warmer the climate becomes. But periods of warm climate were periods of luxuriant vegetation; and the more luxuriant the vegetation, the more carbon dioxide was abstracted from the atmosphere and locked up in deposits of peat and coal. And as the proportion of carbon dioxide in the atmosphere became less, radiation would

[7] That is to say, the principle that the various segments of the earth's crust tend toward equilibrium.

be more rapid and the temperature of the earth would diminish. Furthermore, as the temperature became lower there would be less evaporation, and as a consequence less water vapor in the atmosphere. Thus the blanket would be thinned still more. In the long run, however, there would be compensation. For when the temperature was low and large portions of the continents were covered with ice, the amount of vegetation would be reduced and less carbon dioxide would be taken from the air. The carbon dioxide given off by volcanoes would then accumulate in the atmosphere; the earth's blanket would thus become thicker, as it were; and the climate would become milder. This effect would be reinforced by increased evaporation from the oceans, which would augment the amount of water vapor in the atmosphere, thus still further thickening the blanket and producing a warm climate with luxuriant vegetation, which would then be followed in due course by another period of glaciation.[8]

10. The Explanation of Trade-Winds and Cyclonic Disturbances

In the days of sailing vessels when mariners were dependent upon the winds for propulsion through the sea, it was discovered that there were two belts of constant easterly winds, one to the north and the other to the south of the equatorial region. At and near the equator there was found to be a belt of calms, known as the "doldrums," in which a ship might sometimes lie motionless for weeks at a time. The constant easterly winds are known as the *trade-winds*. The explanation of these winds, if we accept the hypothesis that the earth turns on its axis from west to east, is beautifully simple.

Near the equator the air which is in contact with the ground, or with the water of the oceans, becomes very warm. Rarefied by the heat it is lighter than the air farther from the equator. Consequently in the equatorial regions the air is forced to rise, and the cooler and heavier air from the regions farther north and farther south flows in under it to take its place. The prin-

[8] Cf. Brigham, A. P., *Geology*, Revised Edition, pp. 450 f.

ciple is essentially the same as that by which we explain the "draught" of a stove. And, if it were not for the rotation of the earth, there would simply be a direct northward and southward circulation, the air flowing toward the equator in the lower part of the atmosphere and from the equator in the upper part.

But the earth is rotating from west to east with a speed at the equator of more than a thousand miles an hour; and it tends to carry the atmosphere along with it. It is obvious, however, that in higher latitudes the eastward velocity of the surface of the planet, and therefore of the accompanying atmosphere, is less than at the equator. If we have this difference in velocity clearly in mind, we have the secret of the trade-winds. For the air which flows in toward the equator to take the place of that which rises comes from regions where the eastward motion is less than it is at and near the equator. Accordingly, as it flows toward the equator, it is constantly meeting land and water whose eastward velocity is greater than that, so to speak, to which it is accustomed. Consequently the air in approaching the equator appears, not simply as a north wind or a south wind, but as a north*easterly* wind in the northern part of the torrid zone, and as a south*easterly* wind in the southern part.

Thus the trade-winds are found as easterlies in the tropical regions. In the temperate zones, however, the directions are reversed. Here the prevailing winds come from the west—from the southwest in the northern hemisphere, and from the northwest in the southern hemisphere.

The explanation of these prevailing westerlies is, however, not quite so simple as that of the trade-winds. Suffice it to say (if we may now limit our thought to the northern hemisphere) that, instead of *two* layers of air, as in the tropics—the lower flowing from the northeast toward the southwest, and the upper in the opposite direction—there are in the temperate zone *three* layers. The highest and the lowest of these flow from the southwest toward the northeast, while the intermediate layer flows from the northeast toward the southwest. Why there are three layers instead of two, and why at a latitude of about 30 degrees

there is a region of high pressure, calms, and light baffling winds, the student may learn by reference to treatises on meteorology. He will be fascinated by the success of workers in this field in giving a scientific explanation—yes, a mathematical explanation—of wind and weather.

I venture to add to our account of the prevailing winds a very brief and summary explanation of the storms, or, as they are known technically, the "cyclonic disturbances" which interrupt this regular circulation. Carried by the prevailing westerlies, these storms move in our latitudes with a speed of twenty to thirty miles an hour. A cyclone or cyclonic disturbance is essentially a region of low barometric pressure, which is surrounded for hundreds of miles by a whirling mass of air. The origin and persistence of the area of low pressure result from principles of physics which we cannot discuss. We are chiefly interested in the whirl, which is counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere. The direction of the movement depends upon the same principle as that which is employed in explaining the direction of the trade-winds and the prevailing westerlies. In other words, it is due to the rotation of the earth. The air is flowing in from all sides toward the center, where as it is a region of low barometric pressure, the air is rising. That coming from the regions to the north of the center has (in the northern hemisphere) a slower eastward movement, and that coming from the south has a more rapid eastward movement, than the central area itself. Consequently, instead of coming in from the north, it comes in a curve from the northeast; and, instead of coming in from the south, it comes from the southwest. Thus the counter-clockwise whirl is established.

Here too we have the explanation of the paradox that, while the storms themselves commonly move across the country from the west to the east, periods of extensive precipitation are commonly preceded in our latitudes by easterly and southerly winds; as also of the fact, observed and commented on a century and a half ago by Benjamin Franklin, that the dreaded "northeasters" arrived at Philadelphia before they arrived at Boston.

11. The Explanation of the Tides

A complete account of the tides would include a discussion of the size and shape of the various ocean basins, of the shape of the coast line, and of other factors which obviously play a part in determining tidal movements. The primary cause of the tides, however, is the gravitational attraction of the sun and the moon —particularly of the latter on account of its relative proximity to the earth.

For the sake of simplicity, let us first consider the effect of the moon alone. According to the law of gravitation, the oceans and the solid earth are attracted by the moon with forces inversely proportional to the squares of their respective distances. The earth, being a rigid body, behaves with reference to the moon as if its entire mass were concentrated at its center. We may say then that the solid earth is 4000 miles farther from the moon than the water which is nearest to the moon; while the water on the opposite side of the earth is four thousand miles farther from the moon than the earth itself. Consequently, the solid earth (the lithosphere) is attracted less strongly than the water on the nearer side, and more strongly than the water on the farther side. (The ratio of the three attractions would be approximately $61^2 : 60^2 : 59^2$.) Thus so far as its motion through space is controlled by the attraction of the moon, the solid earth takes a position nearly midway between two heaps of water. The effect of the differential attraction of the moon upon the oceans and the solid earth is, then, to produce *two* protuberances of water, one on the side toward the moon, the other on the side away from the moon. And since the earth rotates on its axis, these seem to move around the earth from east to west.

This, at any rate, would be the situation if there were no continents, but only a uniform expanse of water. The continents, however, interrupt this tidal movement, and, as has been suggested, greatly complicate matters. Moreover, on account of friction, the heaped-up waters, in their (apparent) westward movement, lag considerably behind the moon.

The moon alone would thus produce two high tides and two low tides every day. The gravitational influence of the sun tends to *increase* the tidal effect when sun, earth, and moon (or sun, moon, and earth) are in the same straight line, and to *diminish* the effect when the sun's attraction is at right angles to that of the moon. The former is obviously the case at full and new moon, and the latter at the intermediate phases. It follows that the very highest of the high tides and the very lowest of the low tides come at full moon and at new moon, while the least tidal effect is found at first quarter and at last quarter.

Other Results of Differential Attraction.—The principle which is invoked to explain the tides has other applications, some of which we may touch upon:

(a) It can be demonstrated that one effect of the attraction between the moon and the heaped-up water at the opposite sides of the earth must be to drive the moon farther and farther away from the earth. This follows from the circumstance already mentioned that on account of friction the tide lags somewhat behind the moon in its (apparent) motion from east to west around the earth. Accordingly, the attraction between the moon and the nearer mass of water must tend to accelerate the moon's (real) motion from west to east. But as its velocity in its orbit increases, the distance of the moon from the earth must also increase.

(b) It is easy to show, also, that the friction of the tides with the ocean bottoms and the shores of the continents, which produces the (apparent) lag in westward motion, must have the effect of retarding the earth's rotation. In other words, the tides act as a brake upon the motion of the earth.

(c) It is probable that ages ago, when there was water on the moon, tremendous tides were produced on the lunar surface by the differential attraction of the earth. As a consequence the moon's rate of rotation was slowed down until its period of rotation came to synchronize with its period of revolution, as it does to-day. For this reason the moon always turns the same

face toward the earth, and there is a side of the moon which no human eye has ever seen.

(d) Differential attraction also explains the break-up of comets as they approach the sun and pass out again into space. The parts of the comet which are nearer to the sun are attracted with a much greater force than those which are farther away, and the effect is to spread them farther and farther apart with each return. Indeed, there is reason to believe that in this way several comets have been broken up into swarms of meteors.

(e) By some upholders of the planetesimal hypothesis, which we shall discuss in the next chapter, it has been suggested that the ancestral star from which our solar system evolved was torn asunder billions of years ago, as a consequence of its passing very close to another still larger body, which attracted different parts with different forces.

(f) Finally, if the planetesimal hypothesis be adopted, we might explain the failure of the multitude of planetoids in the belt between the orbit of Mars and that of Jupiter to consolidate into one planet, by referring it to the differential attraction of the giant planet Jupiter upon these smaller bodies.

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CHAPTER III

ASTRONOMY, GEOLOGY, AND PHYSICAL GEOGRAPHY—PERPLEXITIES

1. The Origin of the Solar System

As we trace back the history of the earth our ideas become more and more obscure. The origin of the earth is bound up with that of the solar system, of which it is a part; and when we come to inquire concerning the origin of the solar system we find ourselves perplexed. To be sure, any theory of origins must use the term "origin" in a relative sense. Unless we are to think of an absolute beginning of all things—which it seems to be impossible to do—an "origin" must simply be a hypothetical configuration from which we agree to take our start in attempting to explain subsequent developments.

Most accounts of the earth as a member of the solar system take their start from the conception of some sort of primeval nebula. The two most important hypotheses are those of Laplace and Chamberlin. The former is by far the older; and since it assumed the existence of an original nebula, is commonly known as the "nebular hypothesis." This usage is, however, somewhat misleading; for Chamberlin's hypothesis also presupposes an original nebula, although of a different sort.

(a) The Laplacian or "Nebular" Hypothesis.—Laplace assumed that the original nebula was composed of hot gas. It was supposed to be rotating, and to fill a space even greater than that now occupied by the solar system. As a result of gravitational influence it would be more dense toward the center, and somewhat more rare toward the circumference. As it lost heat through radiation into outer space, this entire whirling mass would contract. It is obvious that this shrinkage would

bring about an increase in the rapidity of rotation. This, in turn, would produce a greater centrifugal (center-fleeing) force, as a consequence of which an outer ring would be detached. On account of gravitational attraction between the parts of this ring, it would eventually be consolidated to form a planet. Thus from the whirling central mass, the remaining portion of which we know as the sun, the planets are supposed to have been thrown off one after another. They, in turn, as they cooled and contracted, would in some cases throw off rings, some of which would subsequently be consolidated to form satellites.

Laplace himself does not seem to have expected his hypothesis to be taken very seriously. Nevertheless it attained widespread acceptance, and is presupposed by popular explanations of hot springs and geysers, of earthquakes and volcanic eruptions, of the origin of mountain-chains, etc., in so far as these explanations depend upon the idea that the earth has a hot molten interior overlaid by a "crust" only a few miles in thickness. Although the Laplacian hypothesis may at first thought seem to be extremely plausible, when it is subjected to a critical analysis it is found to involve serious difficulties.

Thus the inner satellite of Mars revolves about that planet three times while the planet itself rotates but once. Also the small bodies that make up the inner edge of the inner ring of Saturn revolve in only half the time of that planet's rotation. And the ninth satellite of Saturn revolves in a direction opposite to that of Saturn's rotation.

A little reflection will show that these facts are extremely hard to reconcile with the Laplacian hypothesis. For how can a rotating body throw off a satellite which shall have a greater angular velocity than that of its principal, or which shall move in the reverse direction? It is obvious that so far as such satellites, at least, are concerned, some other principle of explanation must be invoked. More serious still, it can be shown by mathematical reasoning that the centrifugal force of the rotating nebula, even if its "moment of momentum" were that represented by the rotation and revolution of all the present components of the

solar system, would not have been sufficient to throw off rings in the manner required by the hypothesis.

A further difficulty arises from the consideration that, even if a ring should be thrown off in the manner supposed by Laplace, there is reason to think that it would cool to solid discrete particles long before it could collect into a spheroid; and hence no secondary ring to form a moon could have developed. Again, a study of the molecular behavior of gases leads to the conclusion that neither the original nebula nor the hypothetical rings would exert sufficient gravitational force at their outer edges to hold gaseous molecules; but that these would be lost one by one into the surrounding space.[1]

(b) The Chamberlin or "Planetesimal" Hypothesis.— The Laplacian hypothesis assumes that the original nebula was gaseous. Chamberlin, on the other hand, assumes that it was composed of a multitude of larger and smaller "planetesimals," or discrete bits of solid matter. Pushing the horizon of explanation back one step more, he and his followers conjecture, as we saw in the final section of the preceding chapter, that such a "planetesimal" nebula might have been produced by reason of the "tidal" effect of a large heavenly body upon another body which it approached rather closely without actually striking. (An actual, head-on collision would perhaps produce the kind of nebula required by the Laplacian hypothesis.)

The larger and smaller portions of solid matter which compose the planetesimal nebula are supposed by Chamberlin and his followers to have been revolving about their common center of gravity, thus producing a rotation of the nebula as a whole. As the smaller planetesimals approached the larger ones in their journey around the center of gravity of the nebula, they would be drawn together by their mutual gravitational attraction. Thus, it is maintained, the planets have been built up to their present size. The fall of meteorites to the earth would, indeed, be but a continuation of the process of earth-building, which no doubt

[1] See Chamberlin and Salisbury, *College Geology*, 1909, pp. 417 ff.; also Moulton, F. R., *Introduction to Astronomy*, Revised Edition, pp. 449 ff.

proceeded much more rapidly eons ago when the regions of space adjacent to the orbit of our planet still contained more planetesimal material.

A test case as between the two hypotheses which we have been considering is afforded by the problem of the origin of the moon. According to the Laplacian hypothesis, as we have seen, the moon is supposed to have been thrown off by the earth, while the latter was still molten, as a result of the centrifugal force produced by the earth's rotation. According to the other hypothesis, however, the moon was at first a separate center of aggregation, a planet or planetoid which had its independent orbit about the sun. Later, it was captured by the earth's attraction, and ever since has played a secondary rôle.

The planetesimal hypothesis, with its theory of the *capture* of the satellites, has an advantage in that it is able to make room for satellites which, as already noted, revolve in a direction opposite to, or with a velocity greater than, the rotational motion of the planet to which they are subordinate; and it is not beset by most of the difficulties which have produced dissatisfaction with the older nebular hypothesis. Recent progress in astronomical research has, however, weakened rather than strengthened the argument for the planetesimal hypothesis, in so far as the latter depended upon analogy with nebulæ observed through the telescope. The spectroscope, indeed, shows that many of the nebulæ are solid rather than gaseous; and many nebulæ when seen through the telescope assume a "spiral" form and are apparently composed of larger and smaller knots with an intermediate haze. These knots were supposed by Chamberlin to be the nuclei of planets, and the intermediate haze to be the smaller planetesimal material which would still be unaggregated. Now, however, astronomers are coming to believe that the spiral nebulæ, instead of being solar systems in the making, are rather to be regarded as very distant star clusters, the components of which are not planetesimals but stars, each of which probably possesses a magnitude comparable to that of our sun.

Neither the old nebular hypothesis nor yet the planetesimal hypothesis can then be regarded as completely established. Perhaps, in spite of the partial withdrawal of astronomical support, the latter remains the more satisfactory. It must be remembered that the Laplacian hypothesis seemed a century ago to be supported by the existence of the rings of Saturn; which were at first supposed to be gaseous, but which have since been found to consist of discrete, solid portions of matter.

All that we can do, then, is to keep an "open mind" until such time as the specialists in the fields of astronomy and geology have come to an agreement. From the point of view of philosophy we are interested in this problem because it leads us to the theory of evolution in its widest aspects. As pointed out in the beginning of this section, no one pretends to describe the original state of affairs, if this adjective is taken in an absolute sense. It is only in a relative sense that we can speak of origins at all. The evolutionist professes no more than to retrace the probable course of events as far as possible. In his account of the distant past and the distant future he may be said to employ the method of "extrapolation." Anyone who has constructed a statistical "curve" or "graph" is familiar with the fact that it is always fairly safe to *interpolate* points between those which have been determined by our data. In the same manner, it is in some cases worth while to *extra*polate a few points before the beginning and after the end of that part of the curve which has been established. Thus in our discussion of cosmic evolution, we may chart the path of progress for some distance before and some distance after the course which has been scientifically determined. Only we must never forget that the farther back and the farther on we go in time, the more hazardous and purely speculative this extrapolation becomes.

2. Is the World-Process Teleological?

By "teleology" we mean the operation of purpose in the production of events. (The term is also used as a name for the theory that purpose is thus operative.) An event or a process is

teleological if it contributes to the fulfillment of purpose. It is obvious, then, that we cannot deny the present rôle of teleology. The Panama Canal, for example, is a teleological phenomenon. It was not produced by merely natural forces, but was the product of intelligence. In the same way, the draining of the swamps, the felling of the forests, the irrigating of the deserts, the building of roads and cities—by which the face of the continent has been changed—all of these are teleological phenomena. Purpose has been achieved, is now being achieved; but this, someone may object, is human purpose.

Our attention is also attracted by the manifestation of purposiveness in the sub-human sphere. The beaver builds its dam; the bird builds its nest; the bee gathers its winter's store of honey. These operations, too, may be considered as evidences of purpose, but of purpose on the level of instinct rather than on that of intelligence.

If, however, we disregard the work of men and of animals, can we still speak significantly of teleology? Is there a superhuman purposiveness? Is there, in short, sufficient evidence for belief in a purposive control of cosmic processes? Was there a plan of the world before the world appeared? Questions such as these certainly deserve a place among the perplexities of science and philosophy.

Arguments for cosmic teleology have been built upon the alleged adaptiveness of our planet to the needs of sentient beings. Just a certain ellipticity of the earth's orbit; just a certain distance of the earth from the sun; just a certain inclination of its axis of rotation to the plane of the ecliptic; just certain proportions in the earth's crust of carbon, oxygen, hydrogen, nitrogen, and the other elements of which our bodies are chiefly composed—all of these, it would appear, and many other nicely adjusted factors are required for the continuance of life as we know it. It is inferred, therefore, that the world could not have arisen through the unguided activity of natural forces, but must have been designed and made by an intelligent, consciously purposive agent.

The conclusion may, indeed, be true; but the argument appears to be faulty in at least two respects:

(a) It is true that life *as we know it* may require the precise combination of factors which is found on our planet, and perhaps nowhere else in the universe. This, however, may be due, not to the adaptation of the environment to the needs of living organisms, but rather to the adaptation of life to the situation in which it has arisen. Instead of speaking of an adaptation *of* the environment we should perhaps speak of an adaptation *to* the environment. The "fitness of the environment," to employ Professor Henderson's phrase, depends upon the nature of that for which it is fit. Carbon, oxygen, nitrogen, hydrogen, etc., the elements which enter most largely into the constitution of living organisms, are relatively abundant. It is conceivable, however, that if other elements had been the most plentiful, these would have become the vehicle of life. And then, too, the environment would have been "fit." Again, life requires a rather narrow range of temperature. But this may be due to the adaptation of life to the temperature of the water or other medium in which it arose.

(b) The inference from adaptedness to teleology appears to be faulty in a second respect. It is an argument from probability, or rather from improbability. Life, it is said, requires a certain combination of factors, and it is highly improbable that this should have occurred without intelligent control. But suppose it to be true that there is only one chance in a million of this precise combination of factors occurring naturally. What follows? Nothing really follows. It is no more wonderful that the millionth chance occurred than that any other of the million chances should have occurred. Or, assuming again that the chance was but one in a million, there may, in fact, have been a million chances. A million worlds, and only one of them fit to be the habitat of living beings! But, it may be said, isn't it wonderful that just this planet of ours, and not some other, should have drawn the lucky number? But if some other world had been the lucky one, *it* would then have been our world. At any

rate, it would then be the denizens of *that* world who would be discussing the problems of teleology and marvelling at the wondrous grace by which their planet should contain the precise combination of factors which are necessary for the existence of life. The case is a little like that of the small boy who gave thanks that he was the son of his own parents rather than of some other adults of his acquaintance.

The argument for cosmic teleology must then be regarded as inconclusive, so long at least as we restrict ourselves to astronomical and geological considerations. When we have surveyed the sciences which deal with life and mind, we shall be in a position to return to the problem. We may conclude our present tentative discussion as follows: On the one hand, it is conceivable that the various stages through which our earth, and the universe at large, have passed in the course of the eons of evolution were planned beforehand; and the record of evolution may be an account of a sequence of creative acts. On the other hand, it is possible that human and lower-than-human purpose may be the only purpose that there is.

The Conception of "Final" Causation.—In our discussion of teleology we have been using the term "purpose" in what appears to me to be its ordinary, everyday sense. There is, however, another more technical sense of the term, the adoption of which would give a different turn to the discussion. In this more technical sense, "purpose" is identified with "final cause."

In the ordinary use of terms, when we speak of the cause of an event we have reference to an event, or to a set or series of events, which always precedes the event in question. In harmony with this usage, "cause" has been defined as "invariable antecedent." And it will probably seem self-evident to most readers that a cause must be earlier in time than its effect. This, however, is true only of what is known technically as the "efficient cause." It is not true of the "final cause," which is by definition that *for the sake of which* the event or process takes place. The "final cause," accordingly, *comes after* the event of which it is the cause!

Let us not say in our haste that this is nonsense. For there is no logical absurdity in the idea of a cause which is later in time than its effect. As we shall see in a minute, this notion of causation may be for most purposes inconvenient, or even useless, but it is not nonsensical.

For, strictly speaking, a cause is not a thing which makes the event happen—whether by pushing from the rear or pulling toward the front—but a cause is an event or combination of events which is so related to the event in question that if the former is given the latter is determined. To employ a mathematical analogy, suppose we know that $2x = y$, and also that $y = 3z$. It follows that if the value of x is given, that of y is determined. Also if z is given, y is determined. Now the relation of x to y is analogous to that of the "efficient cause" to the event of which it is the cause; and the relation of z to y is analogous to that of the "final cause." If, then, a cause is understood to be nothing but a determiner, in the mathematical sense of determining, then there can be no logical objection to speaking of final causes as well as of efficient causes.

In other words, while we ordinarily think of the present as determined by the *past,* there is no absurdity in thinking of the present as determined by the *future.* In practice, however, we meet the difficulty that we usually know a great deal more about the recent past than we know about the future; and it is, accordingly, more convenient, in seeking an explanation of events, to speak in terms of efficient causation than in terms of final causation.

At any rate, the identification of purpose with final cause, which is characteristic of so much discussion of the question of teleology, seems to me to be singularly futile and barren of significance, and merely to lead to a blurring of the issue. For if by the purpose of a process we mean merely that in which it, as a matter of fact, eventuates, or to which it leads, then all processes without exception are purposive. If, however, by "purpose" we mean not simply the *end* but rather a *view* of the end, an idea of the end consciously entertained by some mind,

then the question of cosmic teleology becomes a significant issue.

It is important to recognize that when the term "purpose" is employed in this latter sense, which is, I believe, the ordinary sense, a purpose must be understood to operate, not as a final cause, but as an efficient cause. For in the ordinary sense of the term, the purpose always comes before the process by which it is fulfilled. Purpose, as efficient cause, implies the existence of mind. But if our ideas of the history of our planet are even approximately correct, there must have been a time when it was not the abode of either animal or human intelligence, and when there was consequently no teleology in the sense of human or animal purposiveness. In technical philosophical terminology, the world at that state of its development may have been a mechanism. (See Chap. XII.)

But if it be admitted that the world was a mechanism, it must also be admitted that this mechanism has brought forth within itself an order of purpose—of human purpose, to wit, and of purpose so far as it is exhibited in animal behavior. In short, the mechanism has brought forth teleology, and the teleology is coming more and more to dominate the mechanism. (See further, pp. 356 ff., 421.)

3. What Is the Source of the Light and Heat Given Off by the Sun and the Other "Fixed Stars"?

We have reason to believe that for eons upon eons the sun has been radiating energy into space, only a small part of which is intercepted by our planet. The stars, too, are sources of energy. How is this energy produced? Various theories have been proposed:

(a) The most natural explanation, but upon reflection the least satisfactory, is the theory of combustion. The difficulty is that if the sun were a mass of coal, or of any other combustible material—solid, liquid, or gaseous—that we know anything about, it must long ago have been burnt out; or at any rate, there would have been an observable diminution in the intensity of its rays.

(b) A somewhat more satisfactory theory is the meteoric theory. According to this hypothesis, the heat of the sun is constantly replenished with energy derived from the impact of meteorites which rain in upon it from all directions. It has been calculated that a bit of matter falling to the sun from a distance equal to the radius of Neptune's orbit would develop a quantity of heat thousands of times as great as that produced by burning an equal mass of coal. We can not be sure, however, that the quantity of matter falling in upon the sun from outer space is sufficient to produce the heat which the sun radiates. That meteors fall to the sun is certain. That heat is generated by their fall is equally certain. The only question is whether a sufficient quantity is produced in this way.

(c) Another theory is that the heat of the sun is produced by the contraction of its mass under the influence of gravity. It will be seen that this is not in principle different from the meteoric theory. Instead, however, of thinking of relatively small quantities of matter falling through a distance of millions of miles, we are now thinking of a very great mass falling through a relatively small distance. For the contraction of the sun's mass simply means the falling in of the outer layers upon the inner portion. It has been calculated that an annual shrinkage of 300 feet in the solar diameter would be sufficient to account for the amount of radiation now given off. And at this rate of shrinking it would be more than 8,000 years before the diminution would be sufficient to be observed by the best instruments at our disposal. Thus the contraction theory cannot be disproved. It is clear that as the sun cools it must contract, and that this contraction would involve the fall of the outer layers and the production of heat in the manner just described. According to this theory, then, while the sun would be gradually cooling off, the rate of cooling would be very slow.

(d) Another explanation has, however, come to the front in recent years, which may make the hypothesis of contraction unnecessary, or at any rate may diminish its importance. This is the theory of radioactivity. (See p. 110.) It has been found

that radium, uranium, and certain other substances break down into elements with a smaller atomic weight, and in doing so give off tremendous amounts of energy. We have come to realize that within the atom itself there are great stores of energy, and it is suggested that the sun may contain great quantities of radioactive material, or that our ordinary chemical elements may become radioactive under the conditions prevailing in the sun. Astronomers have discovered that some of the stars are passing through a cycle of development. The theory is that beginning with a red, dwarf, comparatively cool stage they become hotter and hotter and larger and larger, until they glow with a white heat as "giant" stars. Then, having reached a maximum of size and brilliancy, loss of energy exceeds gain, and they become gradually smaller and redder. Our sun is supposed to be in the declining stage of development.

4. How Long Will Our Planet Be Habitable by Man?

The scientist, as scientist, may be as cold-blooded and matter-of-fact as he pleases in developing his view of the world. The philosopher, however, is concerned, not only with the attainment of a logically and factually satisfactory description of reality, but also with human values and aspirations. Anything like a complete account of man's place in the universe must await the completion of our survey of the sciences. There is, however, an interesting question which is suggested by the achievements and perplexities already discussed. It is the question of the future of man upon this planet.

We may limit our view to this planet, because it will probably be a long time before man learns to navigate the interstellar spaces, or even the interplanetary spaces, sufficiently well to permit a migration to any other planet. What might be found in far-distant systems of suns and circling planets in the way of habitations for members of our species we cannot tell. It does not seem likely, however, that any of the other planets of our solar system will be found to be any better adapted than our own to human habitation, or that human beings who might have

migrated to any of the other known planets could survive a catastrophe which would make our planet uninhabitable.

In discussing the length of time which human life is likely to continue upon the earth, let us think, first, of sudden catastrophes which might put an abrupt end to the drama; and, secondly, of gradual processes which might more slowly, but no less surely, bring about an even worse finale.

(a) Possibilities of Sudden Catastrophe.—A possibility which, however improbable it may be, must still be reckoned with, is the chance that our solar system, in its motion through space, might come into collision with some large and massive heavenly body. It might rush upon us from the recesses of space, with a velocity which would become greater and greater as the distance from our sun diminished, and then in a moment of time our solar system, including the earth and all that is therein, might burst into a mass of incandescent vapor! Or, if a collision did not take place, the approach of the heavenly visitant might be sufficiently close, through the effect of differential attraction (see p. 50) to steal some of the planets of our system or to alter their orbits in such a way as to throw them much farther from the sun. Whether our planet were captured by some other sun, or caused to pursue a different orbit about our sun, either vicissitude would in all probability bring about the abrupt termination of human history.

Another possibility of sudden catastrophe is to be found in the chance that our solar system might meet and attract to itself masses of poisonous gases, or of water vapor, or of hydrogen gas, which, combining with our atmosphere, might be fatal for any one of several obvious reasons. Or there might be a period of vulcanism so violent and continuous as to destroy all life. Or again, an upheaval in the sun might produce a disastrous increase in the temperature of the solar system.

That such vicissitudes are possible, and even in the long run probable, is shown by a consideration of the appearance of "new stars." Every now and then a star which had been relatively faint has suddenly blazed forth with greatly increased bright-

ness, either as a result, it is supposed, of a celestial collision, or of an explosion produced we know not how in the body of the star itself.[2] Now our sun is also a star, and what has happened to other stars may eventually happen to it. Indeed, in view of the great number of heavenly bodies it is very probable that in a given century collisions will occur somewhere in the universe; in view, however, of the immensity of the distances between the heavenly bodies, it is very improbable that any given star, as for example our sun, will figure in such a collision within any specified century or millennium. It is to be hoped, accordingly, that no reader will take these possibilities so seriously as to lose any sleep over them.

(b) Gradual Processes Which Might Be Hostile to Man. —Fearful as may be the thought of sudden catastrophe, the contemplation of gradual extinction is even worse. The ancient petition, "from sudden death, good Lord, deliver us," testifies to the dread of an abrupt, unheralded termination of one's existence. Yet most of us, if put to the test, would no doubt prefer sudden death to death by slow torture. And what is true of the individual might also be true of the species. We should, I believe, prefer that man and all his works should suddenly be blotted out, rather than that the race of men should deteriorate, on account of changed environmental conditions, going down to eventual extinction after a process of increasing bestiality.

Many gradual changes of this kind will suggest themselves to the imagination. There might be a gradual diminution of the amount of oxygen in our atmosphere, until it would become incapable of supporting human life. Or through changes in the sun its radiation might be so increased or diminished as eventually to be fatal to man. Or, again, there might be a gradual desiccation of the earth—an extension of the desert area until it would include the entire surface of the planet. This might be brought about by the retreat of the earth's water into the in-

[2] If the increased brightness of the "nova" is only temporary, it is supposed that it passed through a region of space which was more than ordinarily rich in meteoric material.

terior, as the earth becomes progressively cooler. Something of this sort seems to have taken place in the case of the moon, and perhaps of Mars. What geologists tell us, however, of the limitation of the "zone of fracture" (that is to say, the part of the earth's crust within which the weight of the superincumbent material is not so great as to make crevices and fissures impossible) to a layer or shell not more than six or seven miles in thickness seems to make this sort of dénouement rather improbable.

The only redeeming feature in the case of gradual processes hostile to man would be the possibility that man, if warned in time, might be able to control and triumph over them. For, while we may not be justified, as we saw in a previous section, in appealing to cosmic teleology in support of our faith in the future of humanity, teleology in the sense of human purposiveness is, in our part of the cosmos, at least, playing a part of ever-increasing importance. And there is no limit which can be safely set to the growing knowledge and power of man. Man may learn to control the weather; to tap sources of energy which are at present unavailable; to control the motion of the planet itself, thus dropping a little nearer to the sun, or moving a little farther away, as may be necessary to secure the most desirable mean annual temperature!

The Worth-Whileness of Transitory Values.—In spite of considerations of this kind, it is, I fear, more probable than not that *the drama of human history will sometime come to an end*. Suppose, for the sake of the argument, we assume that this will be the case. What shall we say then of human values and ideals? What of the hopes for human progress entertained, in spite of rebuffs and discouragements, by generous souls of a hundred generations? Should we continue, on this assumption, to strive for a "saloonless nation" and a "warless world"? For the conquest of disease, the abolition of poverty, the diminution of ignorance, the improvement of manners and morals, the increase of the spirit of kindliness and consideration for others? Would it still be worth while?

The answer is obvious; and yet it may be well to remind ourselves of it. *Human progress,* in order to be worth while, *does not need to be literally endless.* Transitory values, in spite of their transitoriness, are values still. The artist does not expect his canvas to last forever. The gardener knows full well that in a few days his roses will wither. All that is necessary to justify the striving after values is the reasonable hope that what is achieved will endure for a time commensurate with the effort devoted toward its realization. (See Chap. XV.)

If then we have reason to believe that human life upon this planet will continue for a long time, even if it is not probable that it will continue forever, we are logically justified in working and suffering for the "improvement of man's estate." And while the end *may* come to-morrow or next week, it is probable that a "practical eternity" is still ahead of us. At any rate, this is the view of the eminent sociologist, Lester F. Ward. "Conscious humanity," he tells us in his *Pure Sociology,* "has occupied about one five-hundredth part of the time since the beginning of the Tertiary. There is certainly no probability that the conditions of existence on the globe will begin to decline within a period less than the whole of Tertiary time. The culminating point is at least as remote as three million years from now. But we can scarcely conceive of one million years. That length of time is for all the purposes of a sane philosophy infinite."

A similar position is taken by Chamberlin and Salisbury:[3] "A Psychozoic era, as long as the Cenozoic or the Paleozoic, or an eon as long as the cosmic and the biotic ones, may quite as well be predicted as anything less. . . . The forecast of an eon of intellectual and spiritual development comparable in magnitude to the combined physical and biotic evolutions, lends to the total view of earth-history great moral satisfaction, and the thought that great moral contributions to the higher welfare of the race may realize their fullest fruits by continued influence through scarcely limited ages gives value to life and inspiration to personal endeavor."

[3] *College Geology,* 1909, p. 942.

Someone may, however, object at this point that this sort of consolation is all right for us, but that it does not really meet the issue. How about the people who will be alive three million years from now, or when the Psychozoic era, however long it last, shall be approaching its close? With the prospect of ultimate extinction that much nearer, will it be worth while for them to maintain the struggle?

To this question we may return a twofold answer: In the first place, we may remind ourselves that it is by no means certain that human history will ever come to an end. And three million years from now the end may not seem any nearer than it does to us. In the second place, the demand that human values shall endlessly perdure, natural as it is, does not seem to be based upon any necessary or indubitable ethical principle. It seems rather to be an expression of what in our American election parlance we may call the "band-wagon instinct." And over against the ethics of the "band wagon," in accordance with which nothing is worth while unless it succeeds, we may set the ethics of the sickroom, or of the battlefield, where the hope of victory does, indeed, play its part, but where, in the face of inevitable defeat, the loyal struggle is continued even to the end.

5. Is Reality Finite or Infinite?

To some persons the immensities of space and time revealed by astronomy and geology are a source of inspiration; to others of oppression. All, however, are interested in the attempt to arrive at some sort of intellectual comprehension of the universe; and there are, I should imagine, very few who have not at some time or other debated with themselves the question whether reality is finite or infinite.

If one should "take the wings of the morning" and travel with the speed of light itself to what now appear to us as the confines of space, is it true that he would be no nearer to the end of space than he was at the beginning of his journey? Or, if one could live forever, and keep on always traveling, traveling, traveling, in the manner described, would he get farther and

farther away from home without any limit, or would he at length find himself back at his point of departure?

In the same way, one is perplexed and bewildered when he attempts to think about the lapse of time. Will time ever come to an end? Did it have a beginning? Or are these questions without any meaning, and is time therefore infinite in extent? And, if we assume space and time to be infinite in extent, is the material universe also infinite in mass, extent, and duration?

Before attempting to wrestle further with these problems, it is important that we should distinguish clearly between two related, but yet different, meanings of the adjectives *finite* and *infinite*. In Latin, *finis,* as the reader will of course recall, has the meaning "end" or "boundary." The *fines* were, accordingly, the boundaries or limits of the empire. In asking, then, whether the universe in any of its aspects is finite or infinite, we are inquiring about the existence of *limits* of some sort—of boundaries in space and of beginnings and ends in time.

In addition, however, to this more familiar use of the terms finite and infinite, which we may call their etymological meaning, there is another more technical use, which may be designated as their mathematical meaning. In accordance with this latter sense of our terms, we ask whether, in describing the universe, an omniscient astronomer would have to employ infinite numbers, or whether finite numbers would be sufficient. (We shall not raise the question here as to whether the very conception of "infinite number" involves a contradiction in terms. There will be a brief discussion of this point near the end of Chapter IV.) As we shall see in the sequel, it is logically possible for reality to be finite in the mathematical sense of the term, and yet to be infinite in the etymological sense. In other words, it might include only a definite number of tons or kilograms of matter; a definite number of centuries or millenniums of time; a definite number of cubic miles or cubic light-years of space—and yet be unbounded!

It will now be helpful to divide this question of the finitude or infinity of reality into four subordinate questions:

(a) Is the material universe finite in space?
(b) Is it finite in time?
(c) Is space itself finite?
(d) Is time itself finite?

(a) Is the Material Universe Finite in Space?—Here again a remark is necessary concerning the use of terms. Sometimes astronomers speak of "other universes." *Our* universe would then be only what is more properly spoken of as the "galaxy." If our universe is only one among many universes, then it would of course be finite; since it would be bounded by the confines of the others. Let us not, however, employ the term universe in this way. Let us use it rather in the philosophic sense, as a term to denote the sum-total of reality, or, at any rate, in the present subsection, the sum-total of all material reality. All the "universes" would then be parts of the one Universe.

Shall we say, then, that the universe, thus understood, is finite in space? Now it is manifest that if space could be thought of as having boundaries, or even as being finite in the mathematical sense, the material universe would also be finite in the same sense. For if space is bounded, the universe of matter must be confined within these limits; and if in all space there is but a definite number of cubic light-years of volume, the sum of all those portions of space which are occupied by matter would also be a definite volume.

To make our present question significant we must, accordingly, assume that space itself is infinite in extent. If then matter be supposed to be uniformly distributed throughout infinite space, so that a celestial voyager having traveled to the most distant visible cluster of stars would see other clusters beyond, and so on forever, it would follow that matter would be infinite in amount. It is very doubtful, however, whether the notion of an infinite amount of matter is a defensible concept; for by hypothesis it would all be in existence at the same instant, and would thus involve the difficulty which lurks in the notion of a "completed infinite." If, however, all the matter of

the universe be supposed to be concentrated in some restricted portion (or portions) of infinite space, we arrive at a concept which may, perhaps, be defended. On this supposition, if one traveled in imagination from our solar system, following a straight course out into space, he would come at length to a farthest star, a limit beyond which no more matter would be found. While this conception may thus be free from immediate logical difficulties, there is, however, a physical difficulty. It arises out of our conventions concerning the nature of radiant energy. For if space is infinite and the material universe finite, we must suppose that light and other forms of radiation would pass into empty space never to return. The material universe would then be losing energy constantly; and unless we suppose it to be finite also in point of time, it would long, long ago have become cold, dark, and lifeless.

(b) Is the Material Universe Finite in Time?—Thus we find that the second subdivision of our topic is inextricably bound up with the first. To say that the material universe is finite in point of time would mean (on the assumption that time itself is infinite) that it had a beginning, and that it will have an end; to say that it is infinite in this regard would mean, either that it had no beginning, or that it will never have an end, or, finally, that it is, so to speak, "endless at both ends."

While theologians have usually taught that the material universe was created *ex nihilo*, that is to say, it had a beginning, scientists have been inclined to think of matter as eternal.

(c) Is Space Finite?—We have been considering the theoretical possibility of a finite material universe in an infinite extent of space and time. We have been wondering whether it is possible to think of a realm of matter, limited in mass and volume, and perhaps also limited in duration, which would be surrounded by an infinite extent of space, and be both preceded and followed by an infinite duration of time. It has occurred to us that the problem may be simplified if we can conceive space and time themselves to be finite.

And first, then, we consider the finitude of space. Here, how-

ever, a distinction must be made, which we should, perhaps, have made before. It is the distinction between *imagining* and *conceiving*. It is obvious, indeed, that I cannot imagine a line of infinite length, or a surface or a volume of infinite capacity. For to imagine an infinite, it would be necessary to have it all, so to speak, before the mind's eye, which is of course impossible. It is not so clear, however, that it is impossible to conceive of an infinite space; for, granted that we know the meaning of space and also that we know the meaning of a boundary, it seems possible to combine these two meanings with the idea of negation in order to form the concept of infinite space.

On the other hand, it seems to be impossible to form either an image or a concept of an *end of space*. We are familiar, of course, with bounded spaces; but these are but limited portions of the one Space, of which we are now thinking. Indeed, the very idea of an end or boundary appears to be inseparable from that of more space beyond.

If, then, we are to think of space itself as finite, the concept would seem to be possible, not in the etymological sense of the adjective, but only, if at all, in the mathematical sense. Thus it has been suggested by Minkowski, Einstein, and others that space may be finite and yet unbounded. Just as, when traveling on the surface of the earth, we never come to an end, but the earth's surface is nevertheless known to be less than a certain number of square miles; so in traveling through cosmic space, "with the wings of the morning," or any other means of locomotion, a hypothetical voyager would never come to any "jumping-off-place," and yet the total volume of space might be known to be less than a certain number of cubic light-years.

This doctrine of the finitude of space is a part of the famous doctrine of the "curvature of space," to which we shall return for a brief discussion near the end of the present chapter. Suffice it to say here, that it involves the assumption of one or more dimensions in addition to those recognized by the traditional Euclidean geometry. In accordance with this theory, a straight line, instead of being infinite in length, would, if

sufficiently prolonged, return to the point of origin. Thus our hypothetical cosmic voyager could never get more than a certain distance from home; and if he continued his journey long enough, *traveling always in a straight line,* he would eventually find himself back again at his starting-point. It has been estimated, indeed, that the greatest distance which anything could travel in a straight line before arriving at the point of origin is of the order of 500,000,000,000 light-years, or about 3×10^{24} miles. This may be taken, then, as the maximum length of a straight line. It may never be possible, however, to put these estimates to a direct experimental test, inasmuch as the greatest distance to which even the most powerful telescope enables the human eye to see is less than one-five-hundredth of this distance.

(d) Is Time Finite?—The case of time seems to be even more bewildering than that of space. It seems to be impossible to think of time as finite. This, however, may be due to a defect of our imagination, and may not be a necessary logical inference from the concept of time. In the same way, if by thinking we mean imagining, it is impossible to think of time as infinite, either. If we now shift from the point of view of imagination to that of conception, it is surely possible to think of time as infinite, and it may be possible to think of it as finite.

In thinking of time as finite, however, just as in thinking of space as finite, it must be regarded as finite in the mathematical rather than in the etymological sense of the adjective. In other words, while the maximum lapse of time may be a certain definite number of centuries, we cannot think of time as having either a beginning or an end. For the statement, "Time began" (or "Time will end") is a self-contradictory proposition. If I say, "x began," I mean that there was a time when x was not, and that this was followed by a time when x was. But if I substitute the word *time* for the x, my first proposition becomes, "There was a time when time was not," which is, of course, absurd. (It is evident that with a change of terms the argument

holds against the idea of an end of time, as well as against that of a beginning.)

If, then, time cannot be thought of as bounded, the finitude of time must be conceived in some other manner. It will not do to identify the doctrine that time is finite with the ancient notion of a "series of worlds," or of "eternal recurrence." For this is merely the doctrine that after a sufficiently great lapse of time the same events [4] will again take place in exactly the same order as before. And this is not equivalent to the proposition that the same time recurs. Indeed, the statement, "Time recurs," is just as objectionable from the standpoint of logic as the statement, "Time began." For in trying to think of time as a series of recurring cycles, one finds himself inevitably thinking of a background of linear flowing time with respect to which time is recurring, and this is manifestly absurd.

Let us then try a different form of statement. Instead of saying that time recurs, let us say, instead, that the far, far distant past and the far, far distant future are *identical.* On this supposition, the concept of an infinite duration, which to some minds is distasteful, would not be necessary; and the entire lapse of time might be regarded as constituting an "Eternal Now."

The present writer, however, perhaps for no better reason than that he does not appreciate the mystic attractiveness of the concept of the "Eternal Now," and does not share the rather widespread dislike for the idea of endless duration, prefers to think of time as infinite. On the other hand, he prefers to regard the mass and spatial extent of the universe as finite; for thus we avoid the attempt to think of a "completed infinite," which for reasons that are too intricate to be presented here is a very questionable conception.

This, however, may savor too much of dogmatism. And probably the best conclusion of this fascinating topic would be to confess that we are too ignorant to hold any decided opinion.

[4] One might object even to this that the later event would not, strictly speaking, be the *same event* as the earlier.

6. What Is the Relation of Time to Space?

Partly, I suppose, on account of the difficulties into which the human mind is plunged when it attempts to solve the problems of space and time, there has been a tendency in many schools of philosophy to regard space and time as unreal, or at any rate as possessing but a subordinate and secondary kind of reality. Thus in the philosophy of Kant space and time are treated, not as properties of objective reality (that is to say, of "things-in-themselves"), but rather as *forms of human sense-perception.*

A position somewhat similar to that of Kant has been reached by Minkowski, Lorentz, Einstein, Eddington, Broad, Alexander, and other recent thinkers through an examination of the relation of time and space to each other. The general position thus arrived at is sometimes described by saying that time is to be regarded as a "fourth dimension of space." A more accurate formulation is to say that neither space nor time is fundamentally real; but that both are, as it were, cross-sections of what may, for want of a better name, be called "space-time." This space-time, or as one is tempted to say, "spime," is a four-dimensional reality. Thus time is one of the four dimensions of space-time. And space is a continuum constituted by three dimensions of space-time. Just as there is an indefinite number of planes in our three-dimensional space, so there is an infinite variety of three-dimensional spaces in this four-dimensional space-time. As Eddington [5] puts it, each observer "slices up" space-time into space and time in a manner determined by his own point of view; and no point of view, it should be added, is any better or any worse than any other.

The idea of four dimensions may appear difficult when first presented, but anyone who has mastered the theory of constructing a graph can easily learn to understand it. In order to locate a point on a plane—for example, on an ordinary flat sheet of paper—two values must be given. These are the distances of the point from the two axes with respect to which

[5] *Space, Time, and Gravitation,* 1921, p. 48.

the graph is to be constructed. Suppose, however, that a point is to be located somewhere within the walls of your room. You might be told that the point is a certain distance from the west wall and a certain distance from the south wall. This, however, would not be sufficient to determine the position of the point. You need one more distance—the distance, let us say, from the floor. If, then, you know the distance of the point from the west wall, from the south wall, and from the floor, the position of the point is determined in three-dimensional space. Suppose, however, that instead of a point we now think of an *event*. We shall need another value in order to give a complete account of its position. We shall need to know its *when*, that is to say, its date, as well as the three elements of the *where*. For example, suppose the event to be an explosion in mid-air by which an aviator lost his life. A complete description would include, among other things, the information that the event occurred, let us say, ten miles north of the Mason and Dixon line; three miles east of the Susquehanna River; one mile above sea level; *and* one thousand nine hundred and twenty-five years after the birth of Christ. Nothing less than this would be sufficient; for to determine the event's location in space-time, *four* quantities must be specified.

Somewhat more than this seems to be intended, however, by some of those who assert that time is one of the four dimensions of reality. It is important to recognize that, in some sense at least, these four dimensions are interchangeable; that what is a lapse of time with respect to one observer may be a distance in space with respect to another. In other words, the temporal dimension is no longer regarded as unique.

This, it is said, only carries to its logical conclusion the revolution in men's thinking begun by Copernicus. Before his time men regarded the up-down dimension as unique and unalterable, just as many of us are prone to regard the temporal dimension as unique and unalterable. It was recognized, of course, that the forwards-backwards dimension and the right-hand-lefthand dimension are interchanged whenever one turns

his body through an angle of ninety degrees. But the vertical dimension was supposed to be independent of the others; down was *down,* and that was all that needed to be said. It was not until the Copernican revolution in astronomy that men were forced to stretch their imaginations sufficiently to see that the vertical dimension is constantly being interchanged with the two horizontal dimensions. For if the earth rotates on its axis, it must be admitted that what is now *down* will be *east* six hours from now, and that what is now east will be up. Indeed, it is evident that any of these directions as determined, let us say, by a line from the earth to one of the stars, will be successively, as the earth turns on its axis, down, east, up, west, down, and so on.

In the same way, it is maintained by some thinkers that we shall be obliged to stretch our imaginations so as to realize that the earlier-later dimension is interchangeable with any of the three spatial dimensions of reality; that what is a difference in time for one observer may be a difference in space for another.

Although this is sometimes regarded as an implication of the theory of relativity, it should be noted that Einstein himself does not treat space and time in exactly the same way; for while he regards the former as finite, he nevertheless thinks of the latter as *in*finite.

7. Can Gravitation Be Explained?

The law of gravitation does not tell us *why* the apple falls to the ground, or why the moon pursues its orbit about the earth. Gravity is not a thing which makes bodies attract each other. The law of gravitation, as formulated by Newton, is simply a statement of the fact that any two material bodies which are not held apart will be found to be moving toward each other with a speed depending (1) upon their respective masses; (2) upon the inverse square of the distance between their centers; and (3) upon the time which has elapsed since they began to move in this way. Why bodies behave in this

fashion was left by Newton without any explanation whatsoever.

Perhaps no explanation is possible. In this case the law of gravitation would simply have to be accepted as a "brute fact," as a postulate of descriptive science. Einstein, however, by postulating a fifth dimension of reality, in addition to the four dimensions already recognized in our doctrine of space-time, seeks to give a rational account of gravitation. It is impossible to expound the theory in a few words, but the idea is something like this: In the neighborhood of matter, space-time is warped or puckered in the fifth dimension, and it is this warping which causes such portions of matter as are free to move, to draw together, or as we say, to "attract" each other. The amount of this "curvature" or "warping" of space, and therefore the "force" of the resultant gravitational "attraction," depends upon the amount and nearness of matter. Thus gravitation, instead of being a phenomenon without rational connection with anything else, becomes a property of the "curvature of space" in and near matter. Indeed, Eddington has calculated that a globe of water 570 million kilometers in radius would cause space to curve back into itself. Hence if a drop of matter of this size existed, there would be no room for anything else in the universe.[6]

At this point, however, we must guard against misunderstanding. It is misleading to say that Einstein has refuted Newton, or that Newton's law of gravitation must now be abandoned. The relation between Newton and Einstein is rather comparable to that between two geometers, one of whom should say that the ratio of the circumference to the diameter of a circle is 3.1416, and the other that it is 3.14159.[7] In a word, Einstein's law of gravitation is a more accurate formulation, to which Newton's law is a first approximation. For all ordinary purposes, then, we may safely continue to

[6] Cf. Leigh Page, *Yale Review*, April, 1920, p. 584.

[7] This comparison must not, of course, be taken too literally; for the gravitational formulas of Newton and Einstein are totally different in structure.

base our calculations upon Newton's law. Indeed, the two laws agree so closely in practical application that only two or three cases have thus far been discovered in which the actual difference can be subjected to observation. The most striking case is doubtless that of the advance in the perihelion of the planet Mercury. This is too great to be accounted for by Newton's law in terms of the attraction of other planets; but it is accounted for to a high degree of approximation by calculations based upon Einstein's law.

In addition to this curvature of space in and near portions of matter, which is held to produce the effect which we know as gravitation, there is, according to Einstein, a curvature of space-in-general, by virtue of which space is, as we have seen, *finite* although *unbounded* (see pp. 70 ff). The amount of this curvature is a function of the sum-total of all the matter in the universe. It is then upon estimates of the total amount of all the matter in the universe that some of the disciples of Einstein base their calculations that the maximum length of a straight line is in the neighborhood of 500,000,000,000 light-years. This means that a line longer than this would return to the point of origin, just as a line drawn due east upon the surface of the earth would eventually return to the point from which it started.

It must be noted, of course, that when space is said to be "warped" or "curved," these adjectives are not to be taken quite literally, but that an analogy is intended which like most analogies should not be pressed too far. The meaning appears to be (if for the moment we may neglect the temporal dimension) that our ordinary three-dimensional Euclidean space bears somewhat the same relation to the physical universe as a two-dimensional surface bears to a three-dimensional Euclidean solid. Or (if we may now include the temporal dimension) Minkowski's four-dimensional space-time may, by a not too violent metaphor, be said to be the "surface" of Einstein's five-dimensional world of space, time, and gravitating matter. It follows accordingly that, just as the two-dimensional surface

of a solid object—for example, of the earth—may be *warped* (that is to say, may have hills and hollows) in the third dimension; so four-dimensional space-time may be said to be warped and curved in the fifth dimension.

In concluding this somewhat intricate and involved discussion, it may not be amiss to suggest that in some expositions more mystery than necessary has been associated with the term "dimension." In the case of the three dimensions of Euclidean space, the dimensions are, indeed, measured in directions each of which is at right angles to both the others. It is not necessary, however, that we should think of the fourth dimension, which is time, or of the fifth dimension, which is supposed to account for gravitation, as perpendicular to the others. For perpendicularity is a spatial concept, and need not be included in the generalized concept of dimension. A dimension, as the term is used by mathematicians, is not necessarily a line perpendicular to some other line, but rather a measurable quantity, a value which must be specified in order to give a complete account of whatever it is that is to be described. If then five dimensions are required in order to give a complete account of the spatial, temporal, and gravitational aspects of reality, it is a fair question whether still other dimensions may not be needed to give a description of mental and spiritual phenomena.

That this will be found to be the case is, at any rate, an interesting speculation.

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CHAPTER IV

PHYSICS, CHEMISTRY, AND MATHEMATICS—ACHIEVEMENTS

1. Newton's Three Laws of Motion

After our discussion of the problems of space and time, moving as we have been doing in a somewhat ethereal realm, it may be a relief to come down, if only for little while, to a plane a little nearer to the solid earth. We shall begin our account of the achievements of physics with a topic which ought both logically and chronologically (though perhaps not psychologically) to precede the topic of gravitation. We shall begin with the three laws of motion. These laws usually go by the name of Newton, because he formulated them in the way in which they are ordinarily quoted. They run as follows:

(a) Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it may be compelled by impressed force to change that state.

(b) Change of motion[1] is proportional to the impressed force, and takes place in the direction of the straight line in which the force acts.

(c) To every action there is always an equal and opposite reaction.[2]

The first of these laws is known as the "law of inertia." It teaches, if we may employ an anthropomorphic figure of speech, that, so far as its state of motion or of rest is concerned, every portion of matter strives to remain exactly as it is.

[1] By "change of motion" we are to understand *rate of change of momentum;* and by "impressed force," *impulse.*

[2] Carhart, H. S., *University Physics,* 1903, pp. 45 f. Cf. Crew, H., *General Physics,* Fourth Edition, pp. 73 ff.; Spinney, L. B., *A Textbook of Physics.* Third Edition, pp. 41 ff.; Caswell, A. E., *An Outline of Physics,* 1928, pp. 184 ff.

In other words, it is as if matter desired to *stand pat*. Now the idea of inertia, in so far at least as it asserts a tendency on the part of matter in motion to keep on moving, is contrary to the conception of Aristotle, and also at variance with what seems to be the teaching of everyday experience. Set a grindstone spinning and it will gradually slow down and come to rest; start a pendulum swinging and the amplitude of oscillation will diminish until after a little while the motion will cease; induce a human being to move and he too, after a longer or shorter time, will become quiescent. From observations such as these Aristotle inferred, in agreement with common sense, that all moving bodies have a tendency to slow down and come to rest. The natural state of matter, he thought, is rest. Accordingly he held that material bodies move only so long as they are acted upon by some force; and he argued that there must therefore be some "prime mover" to account for the continuance of motion in the physical world.

We of course see Aristotle's error. He failed to take into account the effect of friction and resistance. Moving bodies do, as a matter of fact, come to rest, as a result of friction with other solid bodies or because of the resistance of air, water, or some other fluid in which they may be immersed. Such friction and resistance would, however, fall under the head of Newton's "impressed force"; and the view held universally by modern physicists is that rest is no more "natural" for material bodies than motion. Indeed, as we shall see in the next chapter, whether a body is said to be at rest or in motion depends entirely upon the thing or things with which it is compared. (See p. 146.)

It is important to observe that Newton's first law, while it has thus superseded the conception entertained by Aristotle, is nevertheless an ideal or hypothetical formulation rather than a statement of fact. It affirms that material bodies will move with a uniform velocity in a straight line except when acted upon by some external force. But the alleged exception is really the rule. It is difficult, if not impossible, to mention any body

which is not acted upon by some force external to itself; and it is probable that no body ever moved with uniform velocity in a straight line.[8] The bodies which come the nearest to fulfilling the conditions of the law of inertia are the heavenly bodies, moving freely through space. Yet, on account of gravitation, they all move in curves rather than in straight lines.

The conditions required by the law are, then, conditions which seem to be always contrary to fact. The best that can be said for this law of inertia is therefore that it is hypothetical. It asserts nothing categorically, but merely tells us that *if* a moving body were not affected by any force external to itself, it would move with a uniform velocity in a straight line.

We must not gain the impression, however, that the first law of motion is erroneous or valueless. It shares its ideal and hypothetical character with all, or nearly all, natural laws; for it is precisely by abstracting from certain elements of actual situations that principles of wide application may be obtained. And while any given law, taken by itself alone, may be in a sense a falsification of reality, a system of such laws, taken collectively, may be an approximately correct description. (See Chapter X, pp. 298 f.)

The other two laws of motion are, strictly speaking, corollaries of the first law rather than independent principles. This is especially clear in regard to the second law, the so-called *law of acceleration.* For if a body unaffected by any external force would move uniformly in a straight line, we should naturally expect that when it is acted upon by such a force the change in its state of motion or rest would be proportional to the force and in the direction in which the force is acting. Indeed, unless we make an exception of those cases in which the force is produced by the contraction of muscle (and may,

[8] Cases may be found, of course, in which the forces acting upon a body are *balanced,* or approximately balanced; and bodies may be thought of as moving with uniform velocity in a straight line for infinitesimal lapses of time.

perhaps, be judged introspectively), there is no way of estimating or expressing the *strength* of a force except in terms of the change of motion which it is capable of producing;[4] and no way of detecting the *direction* in which a force is acting except by observing the direction in which—in so far as its effect is not counterbalanced or modified by other forces—it makes things move. In short, the second law is a circular statement; but in spite of its obvious circularity it is valuable as an explication of ideas which are present implicitly in the first law.[5]

The third law—that action and reaction are equal and in opposite directions—may be illustrated by the case of a book resting upon a table. The book pushes downward on the table and the table pushes upward on the book with equal force. The essential point is that actions go in pairs: for every action there is a reaction; for every force, a counterforce. A somewhat more complicated illustration of this law is afforded by the principle of "recoil," as exemplified by the behavior of a gun. Here, however, we have at least two pairs of actions: action and reaction between the expanding gases and the chamber of the gun, on the one hand; and action and reaction between the expanding gases and the projectile, on the other.[6]

A careful analysis of the meaning of rest and motion will show that the principle of equal momenta, like that of acceleration, is a corollary of the principle of inertia. For if it be true that a state of rest is in no sense a "natural" or preferred condition of material bodies, but that motion and rest are always

[4] We also have the case where force is measured by its effect in producing a deformation of an elastic body, for example, of a spring. (See Bridgman, P. W., *Logic of Physics*, 1927, p. 102.) Nearly all physicists seem to agree, however, in defining force in terms of the rate of change of momentum which it is capable of producing.

[5] We may add that it is possible to reverse the relationship suggested above, and to treat the "first" law of motion as the *zero case* of the "second."

[6] The third law thus includes "what is sometimes called the conservation of momentum, and it may be expressed in modern phraseology as follows: In every action between two bodies, the momentum gained by the one is equal to that lost by the other, or the momenta in opposite directions are the same." (Carhart, H. S., *College Physics*, 1918, p. 11.)

relative to some frame of reference (see p. 146), we should expect that a body in imparting motion to another would itself be impelled to move in the opposite direction.

2. Galileo's Law of Falling Bodies[7]

Although the three laws of motion have come to be associated with the name of Newton, they were already presupposed by the work of Galileo (1564-1642). As in the case of a body assumed to be free from the action of external forces, so also in the case of falling bodies, the weight of authority had been thrown to the support of what we now regard as an erroneous conception. Aristotle, who was regarded in the Middle Ages as an almost infallible authority in all matters of secular knowledge, had taught that the speed with which bodies fall is dependent upon their *mass*.

Aristotle's error is less excusable in this case than in the other; for any one of several obvious and easily performed experiments would have shown the falsity of his theory. Thus, according to the view of Aristotle, if a ten-pound weight falls with a certain velocity, we should expect a twenty-pound weight to fall twice as fast. Here again Aristotle appears to have been misled by his failure to take into account the resistance of the air. It is true that a coin falls more rapidly than a bunch of feathers; but this is due to the greater resistance encountered by the more spread-out mass. That such differences in rate of fall as we are able to observe are caused by the resistance of the air is suggested by the result of a simple experiment. Take a large sheet of paper and let it fall; then take the same paper and crumple it up into as small a volume as possible, and let it fall from the same height as before. The difference which you will observe in the rate of fall cannot be explained as a result of any difference in the mass of the falling body, for it is obvious that the mass of the paper was not changed by crumpling it.

[7] See Crew, H., *General Physics*, Fourth Edition, pp. 96 ff.; Spinney, L. B., *A Textbook of Physics*, Third Edition, pp. 24 f.; Caswell, A. E., *An Outline of Physics*, 1928, pp. 177 ff.

In order to subject Aristotle's hypothesis to a decisive test, Galileo took cannon balls of different weight and dropped them from the leaning tower of Pisa. So far as he could see, they all fell with the same velocity. To make his experiments more precise, Galileo then constructed a smooth inclined plane, down which weights were allowed to slide. Since the rate of descent is slower in this case than when bodies fall vertically, it is easier to record the time. This advantage is partly offset, however, by the fact that it is impossible to make a perfectly smooth plane, and that there will therefore be some retardation on account of friction. Moreover, Galileo had a very primitive chronometer—he measured time by weighing the water which would fall through the hole in the bottom of a small tank while the weight was slipping down the incline; but he was able, after making some allowance for friction, to arrive experimentally at the law connecting the rate of fall with the *time* during which the fall has been in progress. He also worked out the theory of the pendulum, which illustrates and depends upon the same principle.

The law which Galileo thus established may be expressed as follows: If v represents the velocity acquired by a body in its fall, and t the time during which it has been falling, then $v = gt$, where g is the force of gravity. If s represents the space or distance traversed, it is obvious that $s = \frac{1}{2}vt$, from which we may derive by algebraic calculation the formulas $s = \frac{1}{2}gt^2$ and $v^2 = 2gs$.

If a, representing any acceleration whatsoever, is substituted in these formulas for g, we have the more general formulas for the effects of "impressed forces" in accordance with Newton's second law of motion, the law of acceleration. Newton's law of gravitation may then be considered as a wider generalization, combining the three laws of motion with the law of falling bodies, and affirmed to hold true not only in the vicinity of the earth but throughout all space, with a variation, however, in the value of gravity depending upon the distance between the bodies in question. (See p. 31.)

Galileo's work with falling bodies and the pendulum is historically of great importance. In the first place, it contributed to the gradual undermining of the authority of Aristotle, which at the beginning of the modern period was a very serious obstacle in the way of physical inquiry. It is interesting to bring together three erroneous views associated with the name of Aristotle. Aristotle, on the ground that the circle is the perfect figure, and that heavenly bodies must move in the perfect figure, taught that all heavenly bodies move in circles. Kepler found, however, that the planets move in elliptical orbits, and was able to work out the laws of planetary motions. Aristotle taught that everything would come to rest unless it was kept moving by some external force. Galileo and Newton, in agreement with Democritus and the Epicureans, held that a moving body will keep on moving until something stops it; and modern physics is built upon this principle. Again, as we have just seen, Aristotle taught that the velocity of a falling body is a function of its mass; while Galileo proved by experiment that it is a function of time. These views had to make their way against the authority of Aristotle; but once the battle was won in respect to them, it was won all along the line. The method of authority was thoroughly discredited in physics, which became and has remained an experimental science.

In the second place, Galileo's work is important because it introduced the mathematical method into natural science. Mere approximations give way to exact quantitative determinations. To be sure, the accuracy is attained by neglecting discrepancies. The beginner in physical measurements is likely to be surprised and perhaps disappointed to learn that the results of experiment almost never conform exactly with mathematical expectation. The laws of physics are arrived at by *averaging* a great number of experimental results. Nevertheless, as methods and instruments are improved, the agreement with mathematical expectation becomes closer and closer. And as the sciences become more and more mathematical, they become more and more truly scientific.

3. Modern Theories of Heat, Light, and Sound

Everyone, I suppose, has heard the old conundrum, "If in the forest primeval a tree should fall and there were no ear to hear it, would there be any sound"? The answer, of course, depends upon the meaning assigned to the word "sound." If "sound" is taken in a narrowly psychological sense as a species of sensory experience, the answer would be "No, there can be no sound in the absence of an organ of hearing." If, however, "sound" is understood in the sense in which it is employed in physics, the answer would be "Yes, the sound is there whether it is heard or not." According to the physicist, then, sound is not an experience, but rather a property of the objective physical world. Our illustration may be broadened so as to include the cases of heat and light also. Suppose that the tree fell as an incident of a forest fire started by lightning. We might then ask also whether, in the absence of the appropriate sense-organs, there would be any light and heat. Whatever the psychologist might answer, the physicist would say that there would be. For from his point of view heat and light, as well as sound, are properties of the physical world. If now we ask the physicist to tell us what is the nature of these physical realities, he will reply that each is a form of *motion.* Heat is a motion of agitation; light and sound are wave motions.

Rival Theories of Heat.—Probably the best proof of the view that heat is a mode of motion comes from the production of heat by friction, as in Count Rumford's experiment of grinding cannon under water. He found that as long as the grinding went on, there was a continuous and apparently inexhaustible flow of heat. According to the older "caloric" theory it had been supposed that heat was a fluid. Most phenomena could be explained by this theory, and probably in most of our thinking about heat we still employ the figure of a flow. But if heat were literally a fluid, the amount of this fluid contained in the interstices of any given material would be limited, and continued friction could not produce an indefinitely

continued flow of heat as it is found to do. Water can be squeezed out of a wet sponge; but repeated squeezings produce less and less. It follows, therefore, that heat cannot be a fluid contained in the warm substance, as water is contained in a wet sponge. It must be a property or condition which can be imparted by friction to the material which is heated. Now friction always involves *motion;* and the hypothesis which most simply explains the facts in question is that heat is a motion of the molecules which compose the gas, the liquid, or the solid which is said to contain it. Thus the difference between a warm body and a cold body of the same material consists in the fact that the molecules of the former are moving more rapidly than those of the latter. In the conduction or flow of heat from a warmer to a colder body, motion is being imparted by impact of moving molecules in accordance with the principle of conservation of momentum. (See p. 83 n.) And in the production of heat by friction—which, as we have seen, is the crucial phenomenon in deciding between the rival theories—we simply have the transformation of one mode of motion into another. If the motion of molecules may be called "molecular motion," and that of larger bodies "molar motion," when heat is produced by friction, molar motion is transformed—quite in accordance with Newton's laws—into molecular motion. In all cases, of course, in which increasing temperature causes expansion—as, for example, of a steel rail—we have a reversal of this process; that is to say, we have a transformation of molecular motion into molar motion.

General Principles of Wave Motion.—While what we ordinarily understand by heat is thus seen to be a dance of molecules, "radiant heat" is a wave motion. It is really a form of light, which is a wave motion in the "ether" of space. Sound, on the other hand, is a wave motion in air, water, or some other material medium. It is important that the student of philosophy should have a clear understanding both of wave motion in general and of the differences between sound waves and light waves. The principles of wave motion in general can

be learned by observing the undulations produced, let us say, on the surface of a quiet pond by a stone dropped into the water near one of the margins. Little circular waves will travel in all directions from the spot where the stone struck the water. Some of these waves will strike the opposite margin of the pond. But, and this is a very important point, while the wave travels across the pond, it would not be true to say that the water, or any of it, travels across the pond. This is evident if we observe the behavior of a chip floating upon the surface of the pond. The chip does not travel across the pond; it simply moves up and down,[8] dropping into the trough of one wave, rising to the crest of the next, and so on. We must then distinguish between the *motion of the water* and the *motion of the wave* in the water.

The distance through which the vibrating medium—in this case the water—actually moves is known technically as the *amplitude* of the wave. The amplitude of the wave on the surface of the pond is, accordingly, the vertical distance between the bottom of the trough and the top of the crest as revealed by the upward and downward swing of the chip.[9] A definite number of such swings or oscillations will occur each second. This number is the *frequency* of the wave. The distance traveled by the wave in the time of one complete oscillation is the *wave length*. Obviously the wave length multiplied by the frequency will give us the *velocity* of the wave.

We have now defined the concepts required for the understanding of wave motion in general. That we may not confuse wave length and amplitude, let us repeat that:

The *amplitude* is the distance through which successive portions of the vibrating medium actually move.

The *wave length* is the distance through which the *wave*—not the medium—moves, while a given portion of the medium is

[8] Actually the motion of the chip has a horizontal component; but for our present purpose this may be neglected.

[9] Some authorities, however, define the amplitude as the distance between the midpoint of an oscillation and one of the extremes. What has been spoken of above as the amplitude would then be the double-amplitude.

moving from some specified point and then back again to the same point.

It is found in general that the velocity of a certain type of wave is constant within a given medium, but varies from one medium to another. The frequency, however, depends not upon the medium but upon the source of the vibration.

The Nature of Light Waves.—Light waves differ from the waves on the surface of a pond in two important respects: (a) they do not depend upon a material medium for their transmission; and (b) while the oscillation is *transverse*—that is, at right angles to the direction in which the light is traveling—it is not confined to one plane, as is the movement of the chip on the surface of the water.

That light does not depend for its transmission upon any material medium is proved by the fact that it travels through a vacuum. Inasmuch as it seems impossible to think of wave motion without any medium at all, we have been accustomed to say that the motion is in the "ether," which is supposed, somewhat paradoxically, to fill "empty" space, and also to pervade such portions of space as are already filled with matter. (See pp. 135 ff.)

The characteristics of the wave which determine the ordinary properties of light are, however, the same in principle as those of the wave on the surface of the pond. The *intensity* of the light, that is to say, its brightness, is determined by the *amplitude* of the wave. The *color,* on the other hand, is determined by the *wave length* (or by the frequency). The red color has the longest wave, the violet the shortest of the visible spectrum. Below the visible spectrum are the heat rays, with a still longer wave and correspondingly slower frequency than the red. Above the violet are the actinic or "ultraviolet" rays, which have a very short wave and a correspondingly rapid frequency. The only difference among these various types of radiation is a difference in wave length, involving, of course, a difference in frequency. It is worth noting also that the waves upon which "wireless" and "radio" depend are of the same general type

as the light waves. The chief difference is that while visible light waves range in length from about four millionths of a meter in the case of violet to a length nearly twice that great in the case of red, the radio wave lengths are expressed in meters and hundreds of meters.

The Nature of Sound Waves.—Sound waves differ from the waves on the surface of the pond, and also from light waves, in being "longitudinal" rather than transverse. That is, the motion of the medium is in the same direction in which the sound is traveling. Sound also differs from light in that it depends for its transmission upon some material medium, such as air or water. If an electric bell is rung under the receiver of an air-pump, the sound will be heard as long as the receiver is filled with air; but as the air is pumped out, the sound gradually dies away and finally disappears altogether. Since in the case of sound the oscillation is longitudinal, the wave may be thought of as a series of condensations and rarefactions traveling through the elastic medium. The intensity of the sound is determined by the amplitude of the wave, that is to say, by the distance through which successive portions of the air—or whatever the medium in any given case may be—actually move in their rhythmic oscillations. The pitch of the sound, on the other hand, is determined by the wave length (or by the frequency of oscillation). Thus it is the long pipes of the organ that produce the low notes, the short pipes that produce the high notes. Middle C of the pianoforte has a wave length of about four feet and a corresponding frequency of 256. The octave just below has a wave length twice as great and a frequency half as great as that of middle C. And, in general, doubling the wave length or halving the frequency lowers the pitch by one octave, while halving the wave length or doubling the frequency raises the pitch by an octave.

Reducing Quality to Quantity.—Modern theories of heat, light, and sound illustrate the tendency of the sciences to substitute quantitative differences for qualitative differences. Differences in temperature, color, pitch, etc., are explained in terms

of differences in velocity of molecular movement, differences in wave length, etc. Thus science is sometimes said to "reduce quality to quantity." The expression, however, is somewhat misleading; for it may suggest an impoverishing of the real world. In speaking of a reduction of quality to quantity, we need not suppose that the qualitative aspects of our experience are any less real or genuine than the quantitative. For the qualitative aspects of reality are not destroyed or even made to disappear by this "reduction." It is simply a question, so to speak, of translation from one language into another. The language of quantity is more convenient than that of quality, because the former lends itself to mathematical formulation, as the latter does not.

This should be borne in mind in discussing the traditional distinction between primary and secondary qualities. "Primary qualities" are such properties as mass, motion, shape, size; that is to say, the spatio-temporal or quantitative properties of things. "Secondary qualities" include color, sound, temperature, etc. The primary qualities have commonly been regarded as properties of physical objects. The secondary qualities have often been said to be qualities of our experience, but not of the real object. Whether the distinction is a tenable one is a difficult question, to which we shall return in subsequent chapters. (See pp. 143 f., 246 f.)

4. The Law of Conservation

(a) Conservation of Matter.—Suppose you had a piece of wood and wished to destroy it. Would it be possible to do so? In whatever way you "destroyed" the stick—by cutting or breaking or burning—its matter, we have reason to believe, would remain, changed in form but undiminished in amount.

Matter, science has taught, can be neither created nor destroyed. This principle is known as the law of conservation of matter, or of mass. The law cannot be proved, in the sense of strict demonstration; for all alleged proofs take it for granted. Suppose we should try to prove it by weighing a piece of metal

every day for a year or a century, in order to show that the weight of the metal had not changed. It is obvious that the experiment would rest upon the assumption that the weights of our balance[10] had remained the same; and this is precisely the principle which is to be established.

Nevertheless, while the principle of the conservation of mass cannot be proved by experiment, and cannot be established by any analysis of the concept of mass or of matter, it does not run counter to experience; and if due allowance is made for error resulting from the imperfection of our instruments, the principle of conservation is always found to agree with the results obtained by experiment. Considered as a hypothesis, it may be said to be established in the sense that it "works." At any rate, it is the fundamental assumption of all ordinary laboratory procedure in physics and chemistry, and as such has been justified by its fruits.

(b) Conservation of Energy.—A parallel assumption is the principle of the conservation of energy. Energy too, science has taught, can neither be created nor destroyed. It may, however, be *transformed*. Thus the energy found in fuel is transformed into heat; and heat into the expansive force of steam; and this into mechanical motion. Mechanical motion, again, may be transformed into electrical energy; and electrical energy may then be transformed into light, heat, and mechanical motion.

If, now, an exact account is kept of the energy which goes into any process and also of that which comes out, none will be found to have been lost. At any rate, there is found to be a definite ratio between the amounts of the various forms of energy which are dealt with in these transformations, so that a definite quantity of the one always appears when the corresponding quantity of the other has disappeared. And by a proper adjustment of energy units, we thus reach the conception of an energy-in-general which is manifested in a multitude of different ways.

[10] The use of a scale depending on springs would not alter the case in any important respect.

When we come to survey the sciences of the living, we may have to face the question whether the law of conservation is universally true, or whether exceptions must be recognized in the field of life and mind. To some thinkers, indeed, it has seemed important to remind us that the conservation of energy has not been proved in the case of living organisms. They are apparently under the impression that it has been proved for the inorganic realm. And it may not be amiss to suggest that the same sort and degree of demonstration which is possible in the latter case is possible in the former also; and that in our dealings with both the organic and the inorganic realms, the principle of the conservation of energy is an assumption which is found to accord with the results of observation and experiment, rather than a principle which can be rigorously proved by experimental procedure. Speaking in the geometrical manner, we might say conservation is an axiom rather than a theorem.

(c) **Conservation of Mass-Energy.**—Recent work in physics has, however, necessitated a revision of nineteenth-century ideas of conservation. The fact of radioactivity, in particular, has compelled us to recognize a close interrelationship between the concepts of mass and energy. As a result, somewhat in the same way as we have come to substitute the idea of "space-time" for the notions of space *and* time (see p. 74), so we must learn to think of that which is conserved as mass-energy instead of either mass or energy, considered separately. There is reason to believe, indeed, that in the sun and the stars matter is breaking down into radiant energy; and, perhaps, but here speculation is running pretty far ahead of observation, in the distant regions of interstellar space energy is integrating to form matter. Thus the idea of *transformation,* which we have seen to hold true among different forms of energy, would be found to hold as well between energy in general and matter. It has been calculated that the ratio of equivalence between them is that one gram of mass is equal to 9×10^{20} ergs of energy.

5. The Electrical Explanation of Magnetic Phenomena

The theory of magnetism and the theory of electricity both arose out of crude, random observations and were developed as distinct lines of investigation.

Long, long ago it was observed that a certain form of iron ore had the remarkable property of attracting smaller bits of iron. On this account it was known as "lodestone." As much of this material was brought to ancient Greece from a part of Thessaly which was called Magnesia, small portions of it came to be known as *magnets*. When these were suspended freely they were found to take a north and south position, and it was inferred from this that the earth itself is a magnet. It was found also that magnetism is a property which can be propagated. Thus artificial magnets are made by rubbing a piece of steel on lodestone or on another artificial magnet. More extended observation showed that any piece of steel which remained for a long time in a north and south position tended to become magnetic, and that this process could be hastened by jarring or pounding. This strengthened the inference that the earth as a whole is a magnet.

This catalogue of facts practically exhausts what was known of magnetic phenomena prior to the union of the theory of magnetism with the theory of electricity. Studies in electricity had run parallel to those in magnetism. The ancient Greeks had observed that amber, or "electron," to give it its Greek name, when rubbed with wool would attract feathers and other light substances. Other materials which could be electrified in the same manner were discovered. At the beginning of the modern period much attention was given to the study of friction machines, and the electricity made by them was stored in Leyden jars. Then came Franklin's famous kite experiment, which proved that lightning is electricity. And finally the work of Galvani and Volta revealed the possibility of producing continuous currents of electricity by chemical means.

A new era in electrical science began, however, when a

connection was discovered by Faraday (1791-1867) between magnetic and electrical phenomena. It was found that if a helix of insulated copper wire was wound around a core of soft iron and a current was passed through the wire, the iron core would become a temporary magnet. If the direction of the current were reversed, what had been the "north pole" would become the "south pole," and *vice versa*. On the other hand, if a core of iron similarly wound with insulated wire were moved through a magnetic field, a current of electricity would flow through the wire, the direction of the current depending upon the direction of motion through the field. Thus electric currents were found to produce magnetism, and changing magnetism was found to produce electric currents. Most of the modern applications of electrical science, such as dynamos, trolley cars, and so on, depend upon the relation of electricity to magnetism. They are electro-magnetic rather than simply electric or magnetic.

6. The Theory of Quanta

Up to this point in our recital of the achievements of physics, we have confined ourselves almost entirely to what is known as the "classical" or nineteenth-century point of view. It may be desirable, however, to touch briefly upon a doctrine which runs counter to certain nineteenth-century presuppositions, but which promises nevertheless to furnish an explanation of many experimentally verified facts which cannot be included within the traditional rubrics. This revolutionary doctrine, which has probably by this time attained the status of an achievement of science, is the *quantum theory*. This theory was first suggested by Planck, a contemporary German physicist, and has been developed by Einstein, Bohr, Millikan, and others. It is, in brief, the application of the unbroken-package idea to the account of transfers of energy.[11] You must take all of a certain

[11] Strictly speaking, according to recent versions of the quantum theory, the quanta are units of "action" rather than of energy. (See Russell, Bertrand, *The A B C of Atoms*, 1923, pp. 134 f.)

minimum quantity, or you get none. Such a minimum quantity is called a *quantum.* (The plural of *quantum* is *quanta.*)

Let us recall that, according to the accepted dynamic theory of heat (see p. 88) a warm piece of metal—a hot poker, for example—differs from a piece of the same metal which is not so warm in that its molecules are in more rapid movement. Now when heat is transferred by radiation or conduction from a warmer to a cooler body, the velocity of the vibrating molecules is diminished in the case of the former, and increased in the case of the latter. According to the quantum conception, however, the motion of any given molecule is not retarded or accelerated *continuously,* but by a series of jerks or jumps. And in general, so far as this conception holds, changes of energy in a molecule are only possible on the assumption of a jump from one definite state to another.

It is the essence of the quantum theory, then, that transfers of energy take place drop by drop, so to speak, rather than in a continuous stream. Here, however, we must guard against misunderstanding. These "drops," or quanta, are not all of the same size; on the contrary, the amount of energy included in a single quantum is dependent upon the frequency with which the oscillators in question are vibrating. Accordingly, the more rapid the vibration, the greater the minimum amount of energy which can be transferred. This relation is represented by the equation $\varepsilon = h\nu$, in which ε stands for the quantum in question, ν for the frequency of vibration, and h for a definite value which is known as "Planck's constant." [12]

The quantum idea was employed by Planck to explain the distribution of energy in the (visible and invisible) spectrum of a radiating body. It might be expected *a priori* that the amount of energy would continually increase as we pass up the spectrum from the region of slower to that of more rapid vibrations. Instead it has been found that for any given temperature there is a certain band of wave lengths where the intensity

[12] The value of h has been found to be approximately 6.55×10^{-27} ergseconds.

of radiation, as measured by the amount of energy emitted, is a maximum, and that the intensity then diminishes as we go either up or down the spectrum.

If the temperature is increased, the band of maximum intensity moves toward the short wave lengths; if the temperature is diminished, the change is in the opposite direction.

Now the conception of quanta furnishes a satisfactory explanation of these phenomena. For the short wave lengths correspond to rapid vibrations; consequently in that part of the spectrum the quantum, $h\nu$ is large. In other words, in regions of short wave length the vibrating molecules or atoms take up and radiate large amounts of energy, or else none at all; but unless the temperature is sufficiently high, there will not be enough available energy to supply very many of the large quanta required in the upper part of the spectrum. The oscillators which correspond to the short wave lengths will then be in the position of a drayman with a very large truck who refuses to accept less than a full load, and as a result hauls a smaller total tonnage than a drayman whose truck holds less but is always kept busy.

The shifts in the position of the band of maximum intensity of radiation are due to the fact that when the temperature is lowered some of the oscillators which, to continue our figure, had previously been busy all of the time will be required to go on part time; while, when the temperature is increased, some of the oscillators which had previously been busy only part of the time will have sufficient energy to enable them to work full time.

Incidentally, we have here the explanation of the familiar fact that as a piece of steel or of some other metal is heated in a flame its color changes, and if the substance withstands the heat it will run the entire gamut from a dull red to white. The explanation is, of course, that at comparatively low temperatures sufficient energy is available to supply the relatively small quanta required by the oscillators which produce light of long wave lengths and correspondingly low frequency; but

that the available energy is not sufficient to produce any light above the red. As the temperature is increased, however, one spectral color after another is added—as larger and larger quanta can be supplied—until we have the mixture of all in proper proportions to produce white light.

Other phenomena which are explained more simply by the quantum theory than by the classical theory are the following: the variation of specific heat with temperature; the fact that the photo-electric effect, that is, the effect of light in dislodging electrons from the surface of certain metals, is independent of the distance of the target from the source of the light; and the conversion of short waves into longer ones when radiation is re-emitted from a target.

The explanation of these phenomena is too involved for discussion here. Suffice it to say that in all these cases the theory of quanta adopts assumptions which run counter to the traditional principle of the "equipartition of energy." According to this principle, the energy of a warm body would be uniformly distributed among all the possible directions of movement of all the molecules and atoms of the body in question; also energy, when radiated, would be emitted from bodies continuously, in any amount, and at any intensity; radiant energy, having been thus emitted, would spread out uniformly in space, becoming progressively weaker, according to the "law of inverse squares," the farther it traveled from its source.

All of these assumptions were made by nineteenth-century physics, and all are denied by the quantum theory. Some of the oscillators [13] of a warm body, it teaches, may be vibrating, while others remain quiescent. Again, such oscillators as are vibrating may not be moving in all the modes and directions ("degrees of freedom") which might be open to them. And furthermore, as radiant energy travels through space, it is not uniformly distributed but remains concentrated in *rays* or darts, which get farther and farther apart as the distance from the source increases. All of these discontinuities result, according to the

[13] That is to say, molecules, atoms, or electrons.

quantum conception, from the principle that for any given mode of vibration of any given oscillator there must, so to speak, be a full energy-load; and whenever this full load is not available, the particular mode of vibration is simply discontinued.

An interesting confirmation of the quantum theory is afforded by the results of an experiment first performed by Millikan, the winner of a Nobel prize for research in this field. Millikan allowed tiny droplets of oil to float freely in the air between two oppositely charged plates. In some cases the droplets themselves had been electrified, being provided with different charges in successive trials. It was found that, when the droplets had been offered less than a certain minimum charge, they behaved in the electromagnetic field created by the two plates in exactly the same fashion as when their movement was determined by gravity alone. After the droplets had been given this minimum charge, however, they moved upward through the field in opposition to gravity; and further, as the electrification of the droplets was increased, the upward acceleration produced by the electromagnetic field was found to increase by even multiples of the minimum acceleration, without passing through the intermediate values. By this experiment Millikan proved, then, that there is a minimum charge of electricity, and that all actual charges must be even multiples of this minimum charge.[14]

The outstanding problem of contemporary physics is the reconciliation of the quantum theory with the wave theory. Both seem to be required, for each enables us to explain phenomena which the other is unable to account for. It is important to remember that the fundamental notion of the quantum theory, the constancy of the value h, is simply an experimentally verified fact, for which no reason has been given. It is probable, then, that the line of progress will be found in the direction of a modification of the nineteenth-century wave theory, rather than in its complete supersession.

[14] Cf. *Scribner's Magazine*, January, 1925.

7. The Discovery that Most Common Substances Are Compounds

Continuing our survey of the sciences, we turn from this somewhat perplexing conception of contemporary physics to a discovery which has long been recognized as a corner-stone of the science of chemistry. This is the principle that most common substances are compounds of a comparatively small number of elements.

A vague, crude form of this idea had been entertained by some of the ancient Greek thinkers. Our literary use of the term "element," as in the phrases, "exposed to the elements," "the fury of the elements," etc., is reminiscent of this ancient view. For according to the ancient Greek conception it was supposed that everything could be accounted for in terms of but four elements, and these were earth, water, air, and fire.

If, however, we define an "element" as a substance which cannot be analyzed into anything simpler, which is the definition of the term in modern chemistry, it follows that none of the ancient "elements" is really elemental. For water is, of course, a compound of oxygen and hydrogen. Air is a mixture of nitrogen, oxygen, water vapor, carbon dioxide, etc. Earth is a mixture of many different substances, depending upon the place where the sample is secured. While fire is not a thing or substance at all, but rather a process or condition.

It was, indeed, the recognition of the true nature of fire which ushered in that career of conquest which we know as the history of modern chemistry. The older idea had been that in combustion a substance called "phlogiston" was expelled from the fuel. The difference between the better and the poorer fuels was that the former were richer in phlogiston. Apparently the phlogiston, after appearing as flame, passed off finally as smoke into the atmosphere.

This older, mistaken idea that in combustion there is simply a separation of the fuel into two components, one of which escapes as smoke while the other remains behind as ash, is in-

terestingly illustrated by the famous story of Sir Walter Raleigh's wager with Queen Elizabeth. It was in the days when the use of tobacco was first coming in among the courtiers. Sir Walter wagered that he could weigh smoke; the queen wagered that he could not. He "weighed it," and it would appear won the wager, by first weighing the tobacco before it was burnt and then weighing the ashes resulting from the burning and taking the difference between the two weights. This he assumed to be the weight of the smoke. In other words, he assumed that the weight of the ashes added to that of the smoke must equal the weight of the original fuel. We know, however, that weight of ashes plus weight of smoke will be considerably greater than weight of fuel, for the reason that in the burning something is taken up from the atmosphere.

Now the part of the atmosphere which is combined with the fuel in the process of combustion is the *oxygen*. And combustion is known to-day to be a form of "oxidation," that is, the combination of some other element or elements with oxygen. Oxidation, however, is but one of the processes by which in nature and in the laboratory substances are broken up and their elements recombined to form new compounds. Indeed, modern chemistry recognizes only ninety-two elements, of which the thousands of other substances found in daily life and in the industries are compounds.

It is important, however, that we should be clear as to the difference between a compound and a mixture. Thus water we said a little while ago is a compound, while air is a mixture. There are three commonly recognized points of difference:

(a) The constituents of a mixture *can be separated by mechanical means,* such, for example, as filtering, distillation, gravity, or centrifugal force. A compound, on the other hand, can be broken up only by chemical methods. It may, however, be objected that this first point of distinction implies a circle in the reasoning. For it is hard to see any ground of distinction between mechanical means and chemical means except precisely this, that the former is sufficient to separate the constitu-

ents of a mixture, but does not avail in the case of a compound. For example, there seems to be no good reason for calling electrolysis a chemical rather than a mechanical means of separation except the circumstances that it enables us to break up chemical compounds.

(b) The second distinction between a mixture and a compound is that in the case of the former the properties of the resultant can be predicted from a knowledge of those of the constituents. The properties of a mixture of two substances may be considered *a mixture of the properties* of the substances taken separately. Another way of putting it is to say that in the case of a mixture the properties are combined additively. In the case of a compound, on the other hand, if our experience had been confined to the elements, we should have had no idea at all what the properties of the compound would be. For example, common salt is a compound of sodium and chlorine. Now both sodium and chlorine are unpleasant, corrosive substances. If we did not know the properties of salt, we could never infer them from a knowledge, however complete, of the properties of its component elements. In the same way the properties of water are quite different from those of the elements of which it is composed. It does not seem to me, however, that this distinction is entirely satisfactory, either. To consider but one example, mud is a mixture of dust and water. Yet if we had had no experience of the effect of adding water to dust, I suspect that we should be unable to foresee the effect any more than in the case of a chemical compound.

(c) The third, and to my mind the fundamental, point of distinction between mixture and compound is that, in the case of the former, the constituents may be united in *varying proportions,* while, in the case of a compound, there is but one combining ratio. For example, dust and water may be mixed in different proportions to make mud. If more water is taken the mud is thinner; if more dust the mud is thicker. But in the combination of hydrogen and oxygen to make water the proportions are unchangeable. If the elements unite at all they

unite in a definite ratio. Eight parts, by weight, of the oxygen combine with one part of the hydrogen. There is no such thing as varying the proportions and thereby obtaining a little wetter or a little drier water than usual. Instead, a given amount of the one element unites with its due quota of the other, and if more than the proportionate amount of one element is present, it simply remains over. Or if, as in the case of the compounds of carbon and oxygen, there are more than one combining ratio, the resulting compounds have quite different properties, and there is no gradation from one to the other.

That in the formation of the various compounds the elements unite in accordance with fixed ratios is a matter of experimental determination. These experimentally determined facts are explained by the theories of valence and atomic weight. Before explaining the significance of these concepts, two terms must, however, be defined. By a "molecule" is meant the smallest unit of a compound. An "atom" in like manner is the smallest unit of an element. A molecule is, then, made up of a certain number of atoms. Thus a molecule of water is composed of two atoms of hydrogen and one of oxygen. Common salt is one atom of sodium and one atom of chlorine. Carbon dioxide, as the name indicates, is one atom of carbon and two of oxygen; carbon monoxide, one atom of carbon and one of oxygen, etc. Now an element which is able to hold in combination one atom of hydrogen is said to have a valence of one ("valence," from Latin *valeo, valere,* "to be strong"). If it can hold two atoms of hydrogen it has a valence of two; and so on. The atoms, however, are not of equal weight. Thus in the case of water, while the number of hydrogen atoms is twice as great as the number of oxygen atoms, the *weight* of the latter is eight times that of the former. Obviously the atom of oxygen must then be sixteen times the atom of hydrogen. If the atom of hydrogen is taken as unity, oxygen may be said to have an "atomic weight" of 16. Very precise determinations have shown, however, that the ratio of oxygen to hydrogen is slightly less than 16 to 1, and it has been found convenient to treat oxygen as having an

atomic weight of exactly 16, which gives a weight for hydrogen of approximately 1.008.

The Trend toward Unification.—The student of philosophy may wish to pause at this point to look back over the ground already traversed in the present chapter, and also to look ahead. It is worthy of remark, then, that the common principle underlying the last five achievements is the idea that our world is less various than might at first be supposed. Different as are heat, light, and sound as elements of our experience, their physical correlates are all found to be *modes of motion.* Different kinds of energy are found to be transformations of but one Energy. Electric and magnetic phenomena, which at first seemed to be wholly distinct, are found to be, at bottom, the same. Even the theory of quanta, with its suggestion of discontinuity, recognizes the basic constant h. And the seemingly infinite multitude of experienced things are now shown to be analyzable into a limited number of elements.

On the other hand, we have more than fourscore of these elements, in addition to the mysterious somewhat which we call electricity; and many thinkers have assumed the existence of a deep chasm between the inorganic realm and the realm of organisms and organic substances. Science, however, has an incorrigible bent toward a monistic view of the world, and does not regard these remaining pluralisms and dualisms with complacency. Accordingly, the scientist rejoices to discover, as we shall see later (pp. 111 ff.), that the atoms of all the various elements are made up of only two kinds of units, which furthermore appear to be charges of electricity; and also to find that the "chasm" just referred to between the organic and inorganic realms has been bridged.

8. The Artificial Production of "Organic" Compounds

"At first," says the late Professor Ira Remsen,[15] "general chemistry was divided into inorganic and organic chemistry, as it was believed that there were fundamental differences between

[15] *Organic Chemistry,* 1903, p. 1.

the compounds included under the two heads. The compounds which form the mineral part of the earth were treated under the first head, while those which were found ready formed in the organs of plants or animals were the subject of organic chemistry. It was believed that, as the organic compounds are elaborated under the influence of the life process, there must be something about them which distinguishes them from the inorganic compounds in whose formation the life process has no part. Gradually, however, this idea has been abandoned; for, one by one, the compounds which are found in plants and animals have been made in the chemical laboratory, and without the aid of the life process. The first instance of the preparation of an organic compound by an artificial method was that of urea. This substance was obtained by Wöhler in 1828 from ammonium cyanate. When a water solution of the latter is allowed to evaporate, urea is deposited. Up to the time of Wöhler's discovery, the formation of urea, like that of other organic compounds, was thought to be intimately and necessarily connected with life; but it was shown that it could be formed without the intervention of life. Afterward it was shown that potassium cyanide can be made by passing nitrogen over a heated mixture of carbon and potassium carbonate; and, as potassium cyanate can be made from cyanide by oxidation, it follows that urea can be made from the elements. Finally, in 1856, Bertholet succeeded in making potassium formate by passing carbon monoxide over heated potassium hydroxide; and in making acetylene, a compound the composition of which is represented by the formula C_2H_2, by passing electric sparks between electrodes of carbon in an atmosphere of hydrogen. Since that time, every year has witnessed the artificial preparation by purely chemical means of compounds of carbon which are found in the organs of plants and animals."

This suggests the continuity of the organic and the inorganic, of the living and the non-living. If the processes which take place within the organism are in principle the same as those which take place in the so-called inorganic realm, then

biology is merely a subdivision of chemistry. The processes which it studies may be more complex and therefore not so well understood as those studied by chemistry, but they are nevertheless chemical processes. Again, if it is possible to make all the organic compounds in the laboratory, it may sometime be possible to make a living cell out of non-living material. At any rate, the supposition that somewhere, sometime, under some conditions, life arose out of the non-living becomes a thinkable hypothesis. (See pp. 189 ff.)

9. The Theory of Isotopes and Atomic Numbers

When determinations of atomic weights were made, the great majority of them were found to be whole numbers. This suggested the attractive hypothesis that all the other elements are compounds of hydrogen; in other words, that an atom of carbon was actually composed of 12 atoms of hydrogen; an atom of nitrogen of 14 atoms of hydrogen; an atom of oxygen of 16 atoms of hydrogen, and so on, according to the atomic weight of each. Chlorine, however, presented a stumbling-block to the advocates of this hypothesis, for it has an atomic weight of about 35.5. And as the determination of atomic weight became more precise, many other elements were found to have atomic weights which were only approximately integral. Some of these discrepancies have been cleared up by the theory of *isotopes*. Isotopes are elements which have the same chemical properties, but differ in atomic weight. They cannot be distinguished chemically, but in some cases have been separated by mechanical means. Thus it has been found that there are two isotopes of chlorine. One of these has an atomic weight of 35 and the other an atomic weight of 37. It has been suggested that the one should be called chlorine and the other "meta-chlorine." In all samples of chlorine met with in ordinary laboratory practice the two isotopes have been mixed in such a proportion as to give an average atomic weight of nearly 35.5. Isotopes have also been discovered in the case of mercury, nickel, copper, zinc, tin, lead, etc. Some of these are believed to

THE PERIODIC TABLE OF THE CHEMICAL ELEMENTS

0	I	II	III	IV	III	II	I
	1 H 1						
2 He 4	3 Li 7	4 Be 9	5 B 11	6 C 12	7 N 14	8 O 16	9 F 18
10 Ne 20	11 Na 23	12 Mg 24	13 A 27	14 Si 28	15 P 31	16 S 32	17 Cl 35.5
18 Ar 40	19 K 39	20 Ca 40	21 Sc 44	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55
36 Kr 82							
54 Xe 128							
86 Ra 222							

(For the sake of simplicity the table is left incomplete)

be the products of radioactivity in the case of uranium and radium.

The Periodic Table.—The word "isotope" is derived from two Greek words and means "in the same place." Isotopes are so called for the reason that they occupy the same position in the periodic table of the elements. (See p. 108.)

The table is meant to suggest that if they are arranged in a series in the order of their atomic weights, the elements fall into groups. When the table was first arranged, helium, neon, etc., had not been discovered. If, then, one began with lithium and proceeded in the order of the atomic weights, the eighth element was sodium and the fifteenth potassium. And in general it would be found that the eighth or "octave" is more similar to any given element than is an element nearer to it in the series. We are reminded of the relation obtaining among musical tones. With the discovery of additional elements and the attempt to carry the relation out among the elements with higher atomic weights, the musical analogy breaks down. The first and second periods are found to contain eight elements, the third and fourth 18, and the fifth 32. The numbers, 8, 18, and 32 are connected by a curious mathematical relation which may throw some light upon the structure of the atom. The relation is that these numbers are, respectively, twice the squares of 2, 3, and 4.

Atomic Number.—In the above table the number to the right of the symbol for the element is the atomic weight. The number to the left is the *atomic number*. The atomic number may be defined as the number which indicates the position of the element in the periodic table. The original idea was that it indicated the position in the series of elements arranged according to their atomic weight. And in fact, in the case of the lighter elements, the atomic number is half, or nearly half, of the atomic weight. When we come to the heavier elements, however, this ratio no longer holds. There is also a curious discrepancy in the position of argon and potassium. The former has a greater atomic weight, yet it precedes the latter in the

periodic table. On account of its chemical properties it ought to belong to the same group as the other inert gases, helium, neon, etc., and in the same way potassium belongs with lithium and sodium. On account of its properties, then, argon was placed before potassium, in spite of its slightly greater atomic weight. What must have seemed at first to be a "cooking" of the periodic table has been justified by subsequent research. For it has been found that, corresponding to the variation of atomic number, there is a progressive variation in the spectra of the elements; and the relative position of argon and potassium which is indicated by spectroscopic investigation is the same as that which had been arbitrarily introduced. Thus the discrepancy in the atomic number of argon is cleared up; the arrangement of the elements is made to depend upon the characteristics of their spectra rather than upon their relative atomic weight.

10. The Atom as a Miniature Solar System

Many of the facts just discussed are explained by a new theory which regards the atom as a complex structure. The word *atom,* to be sure, comes from two Greek roots which mean "not" and "cut." Literally, then, an atom is that which is uncuttable or indivisible. Although we retain the word, recent discoveries force the admission that the atom is not really indivisible. From this point of view the decisive phenomena are those of radioactivity. It has been discovered that certain elements are disintegrating. The most notable of these radioactive elements are uranium and radium. These elements give off Alpha rays, Beta rays, etc., and strangely enough when the Alpha rays are collected they are found to be helium gas. Several isotopes of lead are also end-products of radioactivity. Now the elements which are found to be radioactive are those with a great atomic weight. The natural inference is that these heavy elements are unstable, and that as they disintegrate, atoms of different kinds are formed, as it were, from their substance.

The facts of radioactivity are explained by the theory, now rather generally accepted, that each of the atoms is really a complex structure. The units which enter into the structure of the atom are called "protons" and "electrons." The protons have (or are) charges of positive electricity; while the electrons have (or are) charges of negative electricity. The protons are all contained in the central portion of the atom, which is called the nucleus. Some of the electrons are also found in the nucleus; others are supposed by the physico-chemist to revolve around the nucleus much as the planets of the solar system revolve around the sun. Thus, while all the protons are in the nucleus, there are two kinds of electrons, nuclear electrons and planetary electrons. The total number of electrons in a given atom is supposed to be exactly equal to the number of protons. There is thus an equilibrium of positive and negative charges in the atom. Another way of putting this is to say that the difference between the number of protons and electrons contained in the nucleus is exactly equal to the number of planetary electrons. Thus hydrogen, the simplest of all the atomic structures, has an atom composed of one proton and one electron. The proton may be considered as the nucleus. In the helium atom there are four protons and two electrons in the nucleus, producing a positive excess of two charges, which is balanced by two planetary electrons.

Planetary Electrons and Atomic Numbers.—Hydrogen has one electron and its atomic number is 1; helium has two planetary electrons and its atomic number is 2; lithium has three planetary electrons and its atomic number is 3. And in general the number of planetary electrons, or in other words the excess of protons over electrons in the nucleus, determines the atomic number. The latter way of putting it is the better; for the other form of statement is really true only in the case of the unelectrified atom. A negatively electrified atom has an excess of planetary electrons, while a positively electrified atom has fewer than the normal number. Assuming, then, that the atom is not electrified, the number of planetary electrons in the atom

of beryllium is 4; in boron, 5; in carbon, 6; in nitrogen, 7; in oxygen, 8; in fluorine, 9; in neon, 10; and so on.

The Atomic Structure of the Inert Gases.—For the sake of simplicity we shall confine ourselves in what follows to the case of the unelectrified atom. It is then immaterial whether we speak of the excess of protons over electrons in the nucleus or of the number of planetary electrons. Either, as we have seen, is the same as the atomic number of the element in question. There is a group of inert gases, most of them discovered in recent decades, which play an important rôle in theories of atomic structure. These are helium, neon, argon, krypton, xenon, and radon.[16] Their atomic numbers are respectively 2, 10, 18, 36, 54, and 86. These constitute the first group in the periodic table (see p. 108). They are said to be inert because it is almost impossible to induce them to enter into chemical combination. They are therefore said to have a valence of 0. They may be thought of as "satisfied" atomic systems. Just in what sense they may be said to be "satisfied" will appear in a moment. It is a question of the arrangement of their planetary electrons. It is supposed that the planetary electrons are arranged about the central nucleus in a series of concentric "rings" or "shells." There appear to be certain distances at which electrons may revolve around the nucleus, and at intermediate distances no electrons are to be found. The helium atom, as we have seen, has two planetary electrons. These constitute the inner ring. This ring cannot contain more than two, and any additional electrons will have to revolve at a greater distance from the nucleus. Of the ten planetary electrons found in the neon atom, two are in the first ring or shell, as in helium, and the remaining eight constitute the second ring. In argon, which has an atomic number of 18, there are again two planetary electrons in the first ring and eight in the second, together with an additional eight in a third ring. In krypton there are two in

[16] This element, to which some chemists have given the name "niton," is now to be known, in accordance with a recent international agreement, as "radon."

the first, eight in the second, eight in the third, and eighteen in a fourth ring. Xenon and radon, to complete the account of the group, have the four rings filled exactly as in krypton, and in addition both have a fifth ring or shell with eighteen electrons, and radon has a sixth ring with thirty-two. In all these atomic systems all the rings are completely filled and no electrons remain over. Every chair at every table is taken, so to speak, and there are just enough places for all. If we may speak metaphorically, these elements have no desire either to gain or to lose electrons. Accordingly they have no affinity for other elements, but, as we have said, are "satisfied."

The Explanation of Valence.—We have seen that in the atoms of the inert gases, helium, neon, etc., the rings or shells of electrons are completely filled, and no electrons are left over. These elements, accordingly, are not seeking either to gain or to lose electrons. Most of the elements, however, are not in this state of blissful indifference. Thus lithium, with an atomic number 3, has one more planetary electron than helium. In the same way, sodium has one more than neon, and potassium one more than argon. If then helium, neon, and argon have just enough to complete their rings, it is obvious that each of these others has one to spare. Lithium, sodium, and potassium have, accordingly, a valence of 1.

On the other hand, fluorine has one less planetary electron than neon, and chlorine has one less than argon. If neon and argon are satisfied, if their rings are complete, there must in the case of both chlorine and fluorine be a deficiency of one electron. These elements, then, also have a valence of 1.

The elements of the latter group are, however, "electronegative," while lithium, sodium, and potassium are "electropositive." If then an atom of sodium is permitted to join forces with an atom of chlorine, the excess in the case of the one will exactly offset the deficiency in the case of the other; for we shall then have two nuclei in the molecule with two complete rings about the one and three complete rings about the other, and no electrons left over.

In the same way beryllium, magnesium, and calcium have two more planetary electrons, respectively, than helium, neon, and argon; while oxygen, sulphur, and chromium have two less, respectively, than neon, argon, and xenon. The elements of the former group are electro-positive, and of the latter electro-negative; but all have a valence of 2. If then calcium enters into combination with chlorine, two atoms of chlorine are required to satisfy one of calcium; but if calcium unites with oxygen or sulphur, one atom of the former exactly satisfies one atom of the latter.

In all cases, then, of the union of two elements to form a chemical compound, the resulting molecule contains two or more nuclei, each of which is surrounded by an exactly complete ring or set of rings of planetary electrons. Indeed, the chemical behavior of the elements is the result of their desire to have complete ring systems, with no electrons left over. And in general, the valence of an element is the number of planetary electrons which it must either gain or lose in order to bring about this consummation.

Electro-positive and Electro-negative Ions.—We have seen that an atom which has more than its normal quota of planetary electrons is negatively charged, while an atom which has less than its quota is positively charged. This follows from the fact that the electron (or the charge which it carries) is a unit of *negative* electricity. We have also seen, however, that lithium, sodium, and potassium, which have one electron in excess of a complete ring-system, are electro-positive; and that chlorine and fluorine, which lack an electron, are electro-negative. Now these two statements may seem, at first, to be mutually contradictory; but the contradiction is only apparent.

For it is only in their ionized condition that the elements are said to be electro-negative or electro-positive. And their behavior in this respect is beautifully explained by the electronic theory of the atom. All that is necessary is to assume that when substances like sodium and chlorine are in solution, the nucleus of the atom tends to assemble about itself an exactly complete

ring system. Thus, although sodium has an excess of 11 positive charges in its nucleus (for its atomic number is 11), and could therefore support 11 planetary electrons, it has in the ionized state a ring system like that of neon, which contains only 10 planetary electrons. Consequently the sodium *ion* has a total *positive* excess of one unit. On the other hand (since its atomic number is 17), the chlorine nucleus can support a ring system of only 17 electrons; but it has in the ionized condition a ring system like that of argon, which contains 18 electrons. As a result, the chlorine *ion* has one more electron than required for electrical equilibrium, and hence has a net *negative* charge of one unit.

Of course, in the sodium-chloride molecule, each charge exactly offsets the other.

The Mechanistic View of the World.—There are still a number of loose ends in this fascinating theory of the structure of the atom. For instance, it is not known for certain whether the successive "rings" or "shells" actually contain electrons to the number of 2, 8, 8, 18, 18, and 32, as suggested earlier, or whether the addition of each new ring increases the capacity of the inner rings so that the latter are able to furnish accommodations for some of the added electrons. Another difficulty is to explain this segregation of the planetary electrons at certain definite distances from the nucleus. One might expect *a priori* that they would be found at all distances within a certain limiting distance. It has been suggested that the arrangement of the revolving electrons in rings or shells is due to their mutual repulsions. A more probable suggestion is that the distance of the electron from the nucleus is determined by its allotment of energy, and that the successive distances at which the electrons revolve correspond to the successive quanta of energy. (See pp. 96 ff.)

Furthermore there is considerable uncertainty as to the nature of the electrons. Some have thought of them as tiny spheres of solid matter which carry charges of electricity. Others have regarded them as unextended centers of force. Ac-

cording to a recent conception, the region surrounding the nucleus is analogous to a "jelly," in which the electrons are nodal points.

All of this is somewhat mysterious; yet, in spite of these difficulties, the electronic theory of the atom—as much, perhaps, by what it promises as by what it has already accomplished—brings a powerful reinforcement to the mechanistic tendency in science and philosophy. For, *in principle,* though not as yet in actual performance, it resolves chemistry into an exceedingly complicated branch of physics. It suggests that the properties of the chemical elements and of their compounds may be treated as functions of moving charges of electricity; and that all chemical properties and processes may thus be accounted for deductively as logical consequences of a few fundamental postulates.

If, then, biology could in like manner be reduced to chemistry, and psychology to biology, the dream of the unification of science would be fulfilled. We should thus arrive at a purely "mechanistic" explanation of the universe; and all science would be nothing but the application of mathematics to the concepts of space, time, and (perhaps) matter.

And even if it be found necessary, as suggested in a previous section (Chapter III, p. 79), to recognize additional "dimensions" of reality in order to account for the phenomena of life and mind, it would still remain true that it is the method and point of view of mathematics which gives color and direction to the work of all the sciences.

With this thought in mind we shall conclude this part of our survey with a brief discussion of three outstanding achievements of mathematics.

11. The Decimal System of Notation

The first of these three "achievements" is the invention and introduction into everyday life of our ordinary method of writing numbers. The decimal system of notation may seem commonplace to us—scarcely worthy of mention in the same breath with the law of conservation or the new theory of the

atom; but this is only because we learned it so early in life that it almost seems to us now as if we had always known it. In reality, however, it is one of the greatest achievements of the human intellect.

There is a sense, it is true, in which nearly all systems of writing numbers are decimal. The Bolans of West Africa are said to have counted by multiples of seven, and the Maoris by multiples of eleven. These, however, are exceptions to the rule. Nearly all early tribes employed their fingers in counting and naturally used multiples of ten or, as in the case of the Aztecs who used both fingers and toes, multiples of twenty.[17] In this sense the Roman system of notation was decimal, for it goes by tens, hundreds, and thousands. And the Romans were merely following the usage of more ancient peoples. "The oldest extant Egyptian and Phœnician writings repeated the symbol for unity as many times (up to 9) as was necessary, and then repeated the symbol for ten as many times (up to 9) as was necessary, and so on. No specimens of Greek numeration of a similar kind are in existence, but there is every reason to believe the testimony of Iamblichus who asserts that this was the method by which the Greeks first expressed numbers in writing." [18] Among the Romans this method of notation was modified to produce a system with which we are still familiar as the "Roman numerals." Separate signs were added for five, fifty, etc., and the convention was introduced that a symbol written before a symbol which represents a larger number is to be subtracted from the latter; as, for example, in IV, IX, XLIX, etc.

What we know, however, in the stricter sense as the "decimal system of notation" was introduced into Europe by the Arabs, who seem to have learned it from the Hindus. It is decimal not merely in the sense in which the Roman system is decimal—in that the numbers are *named* as multiples of ten—but also in the further sense that the value assigned to any

[17] Ball, W. W. R., *History of Mathematics*, Fourth Edition, pp. 122 f.
[18] *Ibid*, p. 126.

given character, as 1, 2, 3, etc., is multiplied or divided by ten if its position is shifted from one column to another. Thus if 2 is written in the second column its value is ten times as great as if written in the first column; in the third column one hundred times, etc. It was an obvious next step—which was not taken, however, until the beginning of the modern period—to place characters in the columns to the right of the first or units' column and thus to obtain a decimal notation for fractions.

The Use of the Abacus.—We may well wonder how the fundamental operations were performed before the introduction of the Arabic notation. Suppose you had to multiply MCCXLVIII by CMXCIX, or to find the square root of CXCVII, how would you proceed? The Romans were able to do more with their unwieldy numerals than we might at first suppose. Multiplication was accomplished by repeated additions, or by the addition of partial products which could be obtained mentally, or copied from tables prepared by someone else. Division could be accomplished by repeated subtractions, or by trial multiplications. The essential thing, then, was to be able to add and subtract. This was done by the help of the abacus or "swan pan," a device which in one form or another has been in use in nearly all parts of the world. It is the simplest sort of *adding machine*. It consists essentially of a number of vertical lines or grooves on or in which pebbles or buttons or some other sort of counters may be placed. A counter in the first column means one, in the second column ten, and so on. By adding or removing the counters the sums and differences of numbers could be obtained without much difficulty. The more complicated multiplications and divisons, not to speak of involution and evolution, were beyond the ability of any but accomplished mathematicians. It is somewhat strange that the users of the abacus did not go on immediately to the principle of the place-value of their numerical symbols, inasmuch as they applied this principle to the counters used in the abacus; but for centuries they were content to employ their numerals merely in keeping a record of the results obtained, and not in the calcu-

lations themselves. The great advantage of the decimal or Arabic system of notation is that the very same symbols which are used to represent numbers may also be used as operative symbols in calculation. We do not need the abacus, because the problem as set down on paper or blackboard is itself an abacus.

12. Symbolic Algebra

Historians of mathematics speak of three kinds of algebra. These are "rhetorical algebra," "syncopated algebra," and "symbolic algebra." In the first kind of algebra, no symbols were used but everything was written out in words. Thus the equation $x^2 + 10x = 39$ was indicated by an Arabian mathematician as follows: "A square and ten of its roots are equal to thirty-nine dirhem; that is, if you add to a square ten roots, then this together equals thirty-nine." In "syncopated algebra" everything was written out in words, just as in rhetorical algebra, except that abbreviations were used for certain frequently recurring operations and ideas. In "symbolic algebra," on the other hand, "all terms and operations are represented by a fully developed symbolism, as for example, $x^2 + 10x = 39$." [19] The chief advantages of this completely symbolic notation are (a) its greater compactness, which allows a long, complicated series of operations to be taken in at a single glance; and (b) its greater power in the solution of problems. This results largely from the employment of symbols for unknown quantities. Here we find the essential point of difference between arithmetic and algebra. In arithmetical analysis we do, indeed, employ phrases to indicate unknowns, such as "the length of the head of the fish," "the number of horses in the field," "the amount of money which Mr. Smith had at first," etc.; but in algebra we simply let x equal the unknown, and after the statement of the problem has been made in terms of x (or in terms of x and y, or of x, y, and z, where there are several unknowns) we can forget all about the meaning of the x, etc., until the calculation has been

[19] Cajori, F., *History of Elementary Mathematics,* Revised Edition, pp. 102 ff.

completed, when the value or values may be supplied in the result. This has become so characteristic of mathematical procedure that, according to Bertrand Russell, "a mathematician does not know what he is talking about, and doesn't care." Thus in mathematical formulas it is possible to attain complete generality. And in the differential and integral calculus it is possible to deal with changing or flowing quantities.

The Generalization of the Idea of Number.—What is a number? Our first answer would probably be to say, "A number is anything like 1, 2, 3, etc." In other words, we should be tempted to restrict the concept *number* to positive integers. The first step in the development of the concept would be to extend its range so as to include fractions as well. But are integers, fractions, and so-called "mixed numbers" the only sorts of numbers there are? No; under the influence of his symbolism, the mathematician has learned to recognize *negative, irrational, imaginary,* and *infinite* numbers.

Each of these extensions of the idea of number met with opposition. Thus, in the case of the first it was objected that the notion of a negative number is a contradiction in terms, for it means a number which is "less than nothing," and this is absurd. The mathematician, however, simply broadened his concept of number in general so as to include the special case of a negative number.

The notion of an irrational number is also open to criticism: for it is really a symbol of a *process,* as for example, the square root of 3, written $\sqrt{3}$ or the cube root of four, written $\sqrt[3]{4}$. And the process of which the irrational number is a symbol is necessarily *incapable of completion.* The case of the imaginary number is, if possible, even worse than that of the irrational; for while an irrational number is a symbol for a process which can never be completed, the imaginary number, for example, $\sqrt{-1}$, is a symbol for an operation which cannot even get started.

The status of the *infinite* number is still a matter of controversy. It is objected that that which is a number cannot be in-

finite, and that that which is infinite cannot be a number. And indeed, if we retain the traditional idea of number, the objection is well taken. The mathematician will, however, do in this case as he did in the others; namely, calmly broaden the meaning of the number-concept so as to include *infinite number* as a new species.

It is important that we should realize the significance of this procedure; for many concepts besides that of number have been, and are being, similarly generalized. As examples we may instance the concept of God, and the concept of religion. Each of these terms is now given a broad, generic meaning of which the older signification is but one among several species.

13. The Idea of Demonstrative Proof

"It is said of certain treatises of the Hindus on geometry that the master, instead of offering a proof of the separate theorems, was content, after stating the proposition, to draw the figure and write under it a word like *Ecce*. The pupil was thus expected to gather intuitively the abstract or general truth from the observation of a single illustration. The student is well aware that the ideal of the Greek geometers was to deduce the theorems of the science from the fewest possible initial assumptions. Whether this ideal be a mistaken one or not, it has at least inspired the procedure of all science down to the present day." [20]

While this idea of rigorous demonstration arose among the Greeks, the method did not become completely self-conscious until the nineteenth century. There are two ways in which we may seek to establish the truth of a proposition. One is the method of observation, experiment, and measurement. The other is the method of demonstration. For example, if one wishes to prove that in a right triangle the square of the hypotenuse is equal to the sum of the squares of the other sides, he might examine a great number of triangles, measuring their sides and finding that within the limits of error incident to meas-

[20] Smith, H. B., *A First Book in Logic*, 1922, pp. 90 f.

urement the theorem holds true. Or to discover the relation between the circumference and the diameter of a circle, one might measure a great many circles and in each case find the ratio of circumference to diameter, and average the results. It is in this way that most of the constants of physics have been found. For example, the specific heat of mercury or of lead would be determined by taking the average of a multitude of experimental results. The mathematician, however, has what he believes to be a better way. He begins by "postulating" certain principles, which themselves cannot be proved but upon which the proof of other principles may be built. In much the same way he develops a system of *definitions*. One term is defined with reference to some other term or terms, and these again with reference to terms previously defined. But it is manifest that, just as in proving our theorems we must start with postulates which cannot be proved, so also in defining our concepts we must start with concepts which cannot themselves be defined. According to the "Helladic" or geometrical ideal of demonstration, however, we try to reduce the *unprovables* and *indefinables* to the smallest number possible.

Axioms and Postulates.—As remarked above, it was only in the nineteenth century that this geometrical method of demonstration became completely self-conscious. A certain teacher of mathematics was accustomed to say that an axiom "is a truth which is self-evident to all persons of sound mind." This is a whimsical statement of the older point of view. It was assumed that there are certain "self-evident truths," and that among these are the axioms of geometry. Modern mathematicians,[21] however, do not define the axioms as self-evident truths. Whether a principle be self-evident or not depends upon the mind to which the evidence is presented. What is self-evident to men of one generation may not be self-evident to those of another. What is self-evident to a given man now may not be self-evident to the same man twenty years from now. It has been found, indeed, that some of the "axioms"

[21] There are, indeed, a few exceptions to this statement.

of Euclid are not self-evident, but that starting with different sets of "axioms" it is possible to construct systems of geometry which are just as rigorous as that of Euclid. Accordingly, it is now generally recognized that, as Schiller of Oxford has put it, "All axioms are postulates." The axioms are no more self-evident than some of the theorems which are made to follow from them. Indeed in some cases it is possible to reverse the traditional arrangement of axiom and theorem: what had been a theorem may be made an axiom, and what had been an axiom will then follow logically as a theorem.

The Proof that $2 + 2 = 4$.—The relations of theorems, postulates, and definitions may become clearer if we raise the question of how we know that the ordinary laws of number are true. How do we know, indeed, that 2 and 2 are 4? For reasons which need not be discussed here, an *empirical* proof, as for example by counting beans or toothpicks, is not logically satisfactory. The philosopher Leibnitz gave a demonstration which will repay study. As stated by Poincaré[22] it runs somewhat as follows:

Let us assume that we know the meaning of *unity* and of *addition*. Then by definition,

$$\text{“}2\text{”} = 1 + 1$$
$$\text{“}3\text{”} = 2 + 1$$
$$\text{“}4\text{”} = 3 + 1$$

Accordingly,

$$\begin{aligned} 2 + 2 &= 2 + (1 + 1) \\ &= (2 + 1) + 1 \\ &= 3 + 1 \\ &= 4 \end{aligned}$$

The demonstration may be criticized on the ground that there is at least one unavowed postulate; namely, that in the process of addition the order of procedure is immaterial. Nevertheless

[22] *The Foundations of Science*, 1913, p. 33.

the demonstration illustrates the general principle that in a mathematical proof we start with indefinable concepts and unproved principles, but attempt to get along with as few indefinables and postulates as we possibly can.

The Mathematical Ideal in Philosophy.—It is important that the student should understand the mathematical ideal inasmuch as it gives color to much of our contemporary philosophy. In inductive science what we call the "facts" are supposed to determine our thinking. General principles are valued only in proportion to their usefulness in explaining the data of experience. When science is presented deductively, however, that is to say, mathematically, the facts should so far as possible be presented as logical consequences of general principles. The epithet "brute facts" is sometimes applied to such data of experience as must simply be accepted without explanation. And from the point of view of a strictly mathematical presentation of science, facts which cannot be inferred from principles must be included among the postulates. Indeed, from this point of view, observation and experiment are preliminary to the real work of science, which is to discover the logical relations of propositions, and to show if possible that all of these can be derived from a few first principles.

Ultimately, however, just as the mathematician must accept his axioms without proof, so even after the sciences have attained the status of deductive disciplines they will have to beg certain first principles. Like the axioms of geometry, the first principles of the sciences must be regarded as postulates; and there is a sense in which all science is founded upon faith. There are, however, two diametrically opposed misunderstandings of this position, against both of which we should be on our guard:

(a) While we recognize the necessity of *postulating* the first principles of the sciences (and of logic and mathematics as well), this does not mean that we have the right to postulate any and every proposition in which we may happen to be interested. For it is a fundamental postulate of logic, which

we all at least implicitly accept, that *postulates should not be multiplied beyond necessity.*

(b) On the other hand, when we say that the fundamental principles of the sciences (just like the axioms of mathematics and the first principles of logic) are postulates, we do not mean that they are untrue, or even that we entertain a doubt concerning them. There is, to be sure, a sense in which the postulates are doubtful. They are doubtful in the sense that no reason can be given for them; but they need not be doubtful in the sense of being actually doubted by any sane mind. Indeed, some of the postulates are harder to doubt than others. (See Chap. X.)

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CHAPTER V

PHYSICS, CHEMISTRY, AND MATHEMATICS—PERPLEXITIES

No exact line can be drawn between the "achievements" and the "perplexities" of the sciences. Accordingly, in some of the points presented under the head of achievements we may have come perilously close to the realm of perplexities, or we may occasionally have overstepped the line. The topics that follow, however, as well as those discussed in Chapter III, will no doubt be admitted by all to belong under the head of perplexities.

1. Will the Universe Run Down?

In a previous section (Chap. III, pp. 62 f.) we discussed the question of the future of our planet and of the solar system as a whole considered as the habitation of sentient and rational beings. From the theory of energy, however, there arises a question whether the entire universe will not eventually run down through the dissipation of energy.

According to the law of conservation, as we have seen, energy can neither be created nor destroyed. (We are neglecting here the possibility of transforming mass into energy, and *vice versa.* See p. 94.) Energy may, however, be changed from one form to another. And some of these transformations do not seem to be completely reversible. Thus the energy of mechanical motion may be transformed into heat, as when a revolving flywheel is brought to rest by friction. Heat can also be transformed into mechanical motion, as takes place, for example, in a steam engine. It is not possible, however, to change all of the heat found in the steam and water of the boiler into mechanical motion. For in order to transform heat into the

motion of wheels and pinions we must, as it were, allow the heat to flow down from a higher to a lower level.

Accordingly, if a time ever comes when all the energy of the universe is uniformly distributed, the possibility of transforming heat into motion will have ceased to exist. In that condition the universe would still contain just as much energy as it does now, or as it ever did—for we are assuming the truth of the law of conservation; and yet none of this energy would be available for human purposes.

An argument for the existence of a creative source of energy is sometimes based upon the "second law of thermodynamics," as this principle has been called. It runs somewhat as follows: The universe has either been finite in time or it has been infinite. Now if the universe be considered finite in time, that is to say, if it had a beginning a finite number of millenniums ago, there must of course have been a creative source of energy; for all the energy which now exists must, on that hypothesis, have been created in the beginning. On the other hand, if the universe be considered infinite in time, that is, if it never had a beginning, on this hypothesis, too, there must be a creative source of energy. For, according to the second law of thermodyanmics, energy is continually becoming unavailable; and, if there has already been an infinite lapse of time, all the energy of the universe would have become unavailable long ago if no new energy had been supplied. Consequently, whether the universe is assumed to be finite or infinite in time, it is necessary to postulate a creative source of energy.[1]

The argument is interesting; but it does not really prove that there has been a creation of energy. What it does prove, and all that it proves, is that, unless we assume a creation of energy, there is an incompatibility between the first and the second law of thermodynamics; and that we cannot hold both laws without qualification. It becomes necessary either (a) to qualify the first law of thermodynamics (the law of conservation), or (b) to qualify the second law by limiting its application to our

[1] Cf. Leighton, J. A., *The Field of Philosophy*, 1923, pp. 169 f.

part of the universe, or to the present eon of time, or else by assuming the existence of some compensating process here and now.

Circumventing the Second Law of Thermodynamics.—The latter method of escaping the difficulty is probably the one which does less violence to the world-view of the sciences. For there is no *a priori* necessity about this second law of thermodynamics. And Maxwell, three-quarters of a century ago, amused himself and his readers with the suggestion of a way in which it might be circumvented.

The suggestion is a deduction from the kinetic theory of gases. Maxwell supposed a gas-filled chamber to be divided into two parts, *A* and *B*, by a partition containing a number of doors. These are supposed to be controlled by a "little demon" who is able to see the moving molecules. By opening and closing the doors at the right times he could allow only the more rapidly moving molecules to pass from *A* to *B*, and only the more slowly moving ones to pass in the reverse direction. In this way there would, after a little while, be an accumulation of the more rapidly moving molecules in *B*. In other words, without an equivalent amount of work the temperature of *B* would be increased and that of *A* would be diminished; and by the principle of the heat engine, a certain amount of work could thus be obtained from what was originally a volume of gas at a uniform temperature.

The suggestion is fanciful; but it shows that it is not theoretically impossible to regather dissipated energy, and suggests the hypothesis that something of this sort may be taking place in nature.

Spencer's Law of Cosmic Evolution.—Herbert Spencer in his *First Principles* suggests that from the point of view of the universe as a whole the evolutionary process may be described as "an integration of matter and a concomitant dissipation of motion." In other words, he holds that, while the matter of the universe is progressively drawing together to form larger and ever larger masses, the energy or motion of the uni-

verse is being progressively scattered throughout space. It is manifest that this law of cosmic evolution is simply a combination of the law of gravitation with the second law of thermodynamics.

Now when Spencer is confronted by the question of the beginning and the end of the evolutionary process, he concludes speculatively that the present cycle of evolution must have been preceded, and will eventually be followed by a cycle of "devolution" in which the process will be reversed. In the evolutionary cycle, we have integration of matter and dissipation of energy; the devolutionary cycle, on the other hand, would be characterized by dissipation of matter and integration of energy.

Carried out to its logical conclusion, this speculation would lead to the recognition of an infinite succession of such cycles, thus returning to the ideas of some of the ancient Greek philosophers who believed in "an infinite series of worlds." In the light of recent suggestions concerning the relation of matter and energy, it may no longer be necessary, however, to place the contrasted phases of the double process of integration and dissipation in successive eons; instead, we may think of them as both going on at the same time. For it is possible, as suggested in a previous section (Chap. III, pp. 61 f.), that in the sun and the stars matter is breaking down and being radiated out into space as light and heat and other forms of radiant energy; and that in the recesses of outer space these energies are again coagulating, as it were, to form matter which then, under the influence of gravity, drifts back to build up stars and solar systems.

In this way the two sides of Spencer's double process of cosmic evolution, like evaporation and rainfall in the terrestrial economy, would be mutually compensating processes.

2. What Do We Mean by Matter and Electricity?

The reader may have heard of the man who, when he was asked, "What is matter?" replied, "Never mind"; and when he

was asked, "What is mind?" made answer, "It does not matter."

Philosophy, however, cannot be satisfied with so summary a disposal of fundamental difficulties. Nevertheless it is not likely that we shall reach a wholly satisfactory solution of the problem of the ultimate nature of matter and electricity. And the question about mind we shall leave for the next two chapters.

Electricity is, of course, mysterious enough; but to the uncritical mind the concept of matter may seem quite obvious. Matter, it may be said, is that which we see, touch, taste, smell, etc. It is that which moves. It is that which we weigh on our scales. It is that which possesses the properties of inertia and gravity. These seem to be obvious elements of our idea of matter. When we think critically, however, it becomes doubtful whether all of these are really properties of matter. For example, some kinds of material substance taste sweet. But is sweetness a property of material substance, or is it a property of our experience? Much can be said in favor of the latter alternative. For one thing, sugar if tasted by a fever patient is found to be not sweet but bitter. Is the sugar, then, really sweet, or is it really bitter? Or is it neither sweet nor bitter?

Perplexities of the same sort arise in the case of temperature. Suppose your right hand to be held for a few minutes in a vessel of hot water, and your left hand in a vessel of cold water. Then, after each hand has become accustomed to the temperature of the water in which it is immersed, let both hands be plunged into a vessel of lukewarm water. Will this water feel warm or cold? The one hand will probably pronounce it warm, and the other cool. But which is it really?

Considerations of this kind, which were made much of by the Sophists of ancient Greece, suggest the theory that taste, temperature, etc., are properties of our experience rather than of physical objects.

Primary and Secondary Qualities.—Considerations of the kind just mentioned are appealed to in support of the widely held view that some qualities are genuine properties of the

physical object, while some other qualities only seem to be so. The former are called "primary qualities" and the latter "secondary qualities." (See p. 92.) Suppose, for example, we have an *idea of a tree*. If we analyze this idea, we find among its constituents such qualities as color, size, shape, motion, and (perhaps) taste, odor, and temperature. Are all of these rightly regarded as objective? The answer given by those who accept the distinction between primary and secondary qualities is that size, shape, mass, and motion, are actually properties of the tree or in general of the physical object; but that color, sound, taste, odor, and temperature, although properties of our *idea* of the object, are not really properties of the object itself.

Whether this distinction can be maintained, or whether all qualities should be regarded as subjective, or all as objective, will be discussed a little farther on. (See pp. 246 f.) We shall, for the present, accept the distinction. The primary qualities, it will be observed, are the spatio-temporal or mechanical properties of the object. From this point of view we may, then, define matter as that which:

(a) occupies space;

(b) resists the occupancy of the same part of space by other portions of matter;

(c) is the subject of motion;

(d) offers resistance to any change in its state of rest or motion;

(e) gravitates toward other portions of matter.

Is Matter an Organization of Electric Charges?—In discussing the structure of atoms we were purposely ambiguous in our account of protons and electrons. A proton, we said, either *is* or *carries* a charge of positive electricity; while an electron either is or carries a charge of negative electricity. Now if the former alternative be adopted, if we say that electrons and protons *are* charges of electricity, we face the paradox that, while the atom considered as a whole is matter, it is doubtful, to say the least, whether the units of which it is composed are themselves material things. While they doubtless move in

accordance with some sort of kinematic laws, it is doubtful whether they can properly be said to occupy space in the sense in which matter is understood to occupy space. If this be the case, while the electrons and protons are the components of matter, they would not themselves be matter.

But how could matter be composed of that which is not matter? This question is unanswerable—if we assume that nothing can be in the effect which was not in the cause; or that nothing can be in a whole which did not previously exist in the parts of which that whole is built up. But the exactly opposite principle, namely, that the whole frequently, and perhaps always, exhibits properties not exhibited by the parts, is just as plausible *a priori*. This principle will meet us every now and then in our subsequent discussions under the name of the *principle of emergence*. It is illustrated by the fact referred to in a former section (p. 103) that, while the properties of a mixture are usually nothing but a mixture of the properties of the constituents which have entered into it, in the case of a compound new properties frequently appear, properties not to be found in the elements from which the compound is formed.

If this principle of emergence can be accepted, there is then nothing so scandalous about the suggestion that matter may be built up out of units which themselves are not matter. To employ a geometrical analogy, a tetrahedron, which is a three-dimensional figure, may be thought of as determined by four points, which have no dimensions at all. In like manner matter, an essential element in the definition of which is the statement that it occupies space, may conceivably be an organization of non-spatial units.

If, then, in accordance with the suggestion just made, matter be regarded as a structure composed of electric charges, the next question is, of course, "What is electricity?" We may as well admit that no answer can be given to this question, except to recite *what electricity does*. Thus an electric charge on a rubber comb or on a glass rod will cause various small objects,

such as bits of feather, paper, etc., to be attracted or repelled. A stream of such charges flowing through a copper wire will produce a magnetic field. And in general, if pressed for a definition of electricity, we might say that electricity is that which acts in accordance with Maxwell's equations.

As a definition this may seem very unsatisfactory; and a great deal has been made of the alleged fact that we can tell what electricity *does,* but cannot tell what it *is.* We may counter, however, by asking, What sort of answer is expected by the one who asks what a thing is? We have seen that in defining matter too, all that we can do is to enumerate a number of things which matter does. Matter is *that which does* thus and so; electricity is *that which does* this, that, and the other; and so on.

In general, then, in defining our concepts, it is well to adopt what we may call a *behavioristic* point of view. Everything must ultimately be defined as a "that which . . ." In other words, *a thing is what it does;* and to attempt to find some substance or nature underneath or behind the thing's behavior is to chase a will-o'-the-wisp.

3. Is There One Fundamental Material Substance, of Which the So-Called Ninety-Two Elements Are Transmutations?

In the Middle Ages the alchemists sought for some method by which "base metals" might be changed into gold. Laws were actually passed forbidding the practice of alchemy, not because the quest was impossible, or because the seekers were wasting their time, but for fear lest the manufacture of gold should cheapen the coin of the realm.

Nineteenth-century chemistry, with its doctrine of more than fourscore immutable elements, regarded as absurd both the hopes of the alchemists and the fears of their rulers. Twentieth-century chemistry, however, is not so sure of this. Perhaps the alchemists were not so foolish after all! If, as now seems to be established, the atoms of all the so-called elements are struc-

tures composed of protons and electrons, transmutation is theoretically possible. For it is as if all kinds of houses were built of but two kinds of bricks. If this were the case, by tearing down a sufficient number of the less valuable houses, material could be found for the erection of any kind of house whatsoever.

It is, then, theoretically possible, in the light of recent theories of the structure of the atom, to transmute other elements, as for example mercury, into gold. Indeed, some workers think that they have already accomplished this feat; but their claims are disputed by other competent laboratory men. And it may turn out to be more important to produce the more useful metals; such, for example, as copper or lead.

A closely related but somewhat more radical question is also suggested by the contemporary theory of the atom. It is the question of the existence of a single fundamental substance or stuff, of which all substances are transmutations. Newspapers and magazines, toothpicks and telephone poles, are all made of one substance—wood; knives and needles and watch-springs are all made of one substance—steel. Is there now, in the same sense, some one substance of which all things are made? The ancient Greeks had wrestled with this problem, and had answered it in the affirmative. According to Thales, all things are modifications of water.

Thales' answer is, of course, too naïve for the twentieth century. Instead of water, we might be disposed to say, electricity. There are, however, two kinds of electricity; or, at any rate, two kinds of units—protons and electrons—which are included in the structure of the atom. Thus we still have a dualism and not a monism. It may, however, be permissible to speculate that this final (material) dualism may yet be overcome.

Perhaps the proton is not simple but is itself a peculiar combination of electrons. Perhaps it is only a modified or inverted electron—an electron turned inside-out, so to speak. Perhaps both protons and electrons are built up out of more ultimate units—atoms of ether, for example—which are all of the same

kind. Or perhaps protons and electrons are opposite humps or kinks of four-dimensional space-time in a fifth or sixth dimension. In short, it may be conjectured that the dualism with which we seem to be confronted is only apparent, and that the *two* are really *one*.

While the hypothesis of one ultimate kind of reality, of which both protons and electrons may be supposed to be different structures or opposed manifestations, is very attractive, it must however be admitted that there is as yet little or no experimental evidence in its favor; and at the present stage of science, electrons and protons must still be regarded as qualitatively distinct.

4. Does the Ether Exist?

No one has ever seen, tasted, or handled the "luminiferous ether." It has been assumed to exist in order to aid the imagination in picturing the voyage of a beam of light across a vacuum; or, more generally, to explain electromagnetic phenomena in so far as they involve action at a distance.

Some contemporary thinkers maintain, however, that the hypothesis of the ether is unnecessary and in conflict with the results of experiment. These thinkers suggest that "waves" of light, and of other forms of radiant energy, should be thought of as no more than exceedingly rapid reversals of a field of force. There are at least two objections to this proposal: (a) The idea of a "field of force" seems itself to require the conception of the ether. If the "field" is filled with an elastic medium such as the ether is supposed to be, it is easy to think of stresses and strains in this medium; but if there is no such medium and space is literally empty, it is very hard to attach any meaning to the phrase "field of force." (b) The fact that light requires time to travel from one position in space to another seems to require an intervening medium. If the "light waves" are simply rapid reversals of a field of force, we should expect the reversal to be instantaneous throughout all that portion of space to which the light extends. That time is required,

that some portions of the intervening space are at one phase of the reversal of the field while other portions are at a different phase, requires us to endow this intervening space with properties very like those which have been traditionally ascribed to the ether.

The suggestion of Professor Montague[2] that the intervening space is filled with a multitude of fields of force, and that a light wave traversing space is a successive deformation of these fields, ignores the first difficulty mentioned in the preceding paragraph, but seems to escape the second. I say *seems* to escape, because a space filled with these successive fields of force would to all intents and purposes be a space filled with the ether. The suggestion would involve a change of name. We used to call it "ether"; now we call it "fields of force."

The Michelson-Morley Experiment.—We have been discussing the difficulties which arise when we attempt to dispense with the idea of the ether. There are, however, grave difficulties on the other side of the question, too. One of these is brought to our attention by the famous experiment performed by Michelson and Morley. An easy calculation shows that in its journey round the sun the earth travels at the rate of eighteen miles per second. Now if space is filled with ether, the earth is moving with this velocity through a sea of ether. Or we might think of the ether as flowing by and through the earth at the rate of eighteen miles per second. Whichever way we think of it, if the ether exists this motion ought to be capable of experimental verification. Michelson and Morley split a ray of light into two parts, and by a suitable arrangement of mirrors caused each half to travel a certain distance and back again to the point of origin. While the distance traveled by each was the same, the one was made to travel in the line in which the earth was moving at the time, and the other was made to travel at right angles to the earth's movement. If the earth in its motion is really passing through the ether, or the ether flowing by the earth, we should expect the light which traveled transversely to get back to the

[2] *Philosophical Review*, March, 1924.

starting-point a little sooner.[3] This difference in time of return would be represented by a difference in the phase of the two halves of the beam, and when they were reunited would be revealed by interference bands. The exact difference in time of return had been calculated, and the apparatus would have revealed this difference if it had existed. But no such difference appeared; the two halves of the beam got back at the same time. Or at any rate, the difference in the time of return and the consequent alteration in the interference bands were so much less than would be expected on the assumption that the earth was moving through the ether at a speed of eighteen miles a second that the result was described as virtually null.

This "negative" result of the Michelson-Morley experiment is important historically, because it was one of the influences which called forth the theory of relativity as formulated by Einstein. Our present interest in this famous experiment results, however, from the fact that it seems to disprove the existence of the ether.

Defenders of the ether have not been slow to point out, however, that the inferences which have been drawn from the experiment depend upon the assumption that the velocity of light is constant. This does not mean, of course, that light has the same velocity in all transparent media, as, for example, air, water, glass, etc.—for it is well known that its velocity differs in different media—but merely that *in a vacuum* it always travels at the rate of approximately 186,000 miles or 300,000 kilometers per second, *regardless of the velocity of the source* from which it was emitted.

Now the experimental evidence for the constancy of the velocity of light is meager, and until a decisive experiment is devised and performed the question must remain in suspense. If light is a wave motion in the ether, we might expect its velocity to be independent of that of its source; but if the idea of the

[3] The stock illustration of this is to calculate the time required for a swimmer to swim a certain distance upstream and back to his starting-point, as compared with the time required to swim an equal distance transversely to the current and back to the starting-point.

ether is given up, there is no longer any *a priori* reason for denying that its velocity may be determined in part by that of its source.[4]

Moreover, the work of Dayton Miller on Mount Wilson seems to establish the fact of a motion of the earth with respect to the ether, after all.[5] The "ether drift" revealed by his experiment is much less, however, than would be expected; and recent work by Michelson himself with greatly improved apparatus[6] confirms the latter's original findings.

It is too early to predict the final outcome of these investigations. We can only suspend judgment until those who are expert in the fields of physics, astronomy, and mathematics arrive at a decision. In the meantime one may perhaps be permitted to conjecture that the concept of the ether, having been as it were on probation for a while, is now about to be restored to good standing. Indeed the properties assigned to space (or to "space-time") by the contemporary theory of relativity are surprisingly similar to those of the old-fashioned ether. "If relativity ignores the ether," says Dr. Paul R. Heyl, "does it not introduce what is to all intents and purposes its equivalent? . . . Einstein supposes space itself to be enough of an entity to have a curvature, and to be 'empty' only where and when it is flat. But if space can be bent and straighten out again, why can it not repeat this process with sufficient rapidity to be called a vibration? . . . Back in every one of our heads is the idea that there is something . . . which is responsible for our sensations of light and electricity; and whether we spell it e-t-h-e-r or s-p-a-c-e, what does it matter?"[7]

5. Are Our Units of Length, Mass, and Time Constant, or Are They Relative Values?

As everyone knows, the centimeter, the gram, and the second are the fundamental units of physical science; and it is therefore

[4] See Montague, *op. cit.*
[5] See *Science*, June 19, 1925, and April 30, 1926.
[6] See *Science News-Letter*, 1928, pp. 287 and 303.
[7] See *Science News-Letter*, 1928, p. 287.

somewhat disconcerting to be told by Albert Einstein and his disciples that these units are all variable. We of course have known that the standard meter and the standard gram must be guarded very carefully against corrosion; and that in the case of the former measurements must be made at a standard temperature; while in the case of the latter the weight of the same mass would be different in different parts of the world. We have known, too, that there is no standard hour or second laid up for future reference in some Bureau of Standards in Paris or London or Washington; but that our unit of time is simply a fraction of the period required for a rotation of the earth with respect to the "fixed" stars; and that changes are readily imaginable in the shape of the earth which would alter the length of a second.

It has seemed to many of us, however, that, although changes may take place in any actual meter stick or gram weight, and although it is probable that there are variations in the time required for the diurnal rotation of our planet, there must nevertheless be an absolute centimeter, an absolute gram, and an absolute second which somehow remain unaltered in spite of such changes in our actual standards of measurement.

It is however this possibility of an even theoretically constant length, mass, or time that Einstein denies; and it is this denial which some of us find so disconcerting. For according to the newer physics, length, mass, and time, instead of being constant quantities, are functions of velocity of movement; so that the mass of a rapidly moving particle is *greater* than that of the same particle at rest, and its length and its associated time-lapse are correspondingly *less*.[8] If, then, our ideas of length, mass, and time are relative, what is left? Is there no solid basis of actual fact, no realm of being that is independent of changes in human ways of thinking; but is everything, including all that we have been wont to think of as belonging to "objective reality,"

[8] It must be borne in mind, of course, that these changes occur only from the point of view of an observer with respect to whom the motion takes place.

dependent upon the point of view of the observer? In short, is it true that *man,* and indeed every individual observer, is the "measure of all things"?

These new ideas are not quite so disturbing, however, after we have had time to think them over, as they were at the shock of first acquaintance. For in the first place, at all ordinary velocities these variations are so small as to be negligible. Indeed no changes in length, mass, or time are observable until we have to do with velocities of thousands of miles per second. And in the second place, even if a body is moving at a speed sufficient to produce a very considerable change in its length and mass as well as in the time indicated by a clock associated with it, these changes would not be perceived by an observer who is moving with the body in question. For, inasmuch as there is no such thing as absolute motion or as absolute rest, the moving body would be at rest with respect to such an observer. (See p. 146.) Our account of "changes" in length, mass, and time-lapse is then not quite accurate. We should say, rather, that all properties of bodies are *relative* to some specified frame of reference.

The Theory of Relativity.—It would of course be absurd to expect that we should at this stage in our mastery of science and philosophy arrive at a complete understanding of the theory of relativity. There are however degrees of understanding. No one, probably not even Einstein himself, would lay claim to a complete mastery of all that is involved in this point of view; and even we may hope to gain some slight idea, at least, of what it is all about.

The theory of relativity is presented, then, as an inference, or a body of inferences, from two fundamental principles. One of these, which we have already touched upon briefly, is the principle of the constancy of the velocity of light. The other, known specifically as the principle of relativity, is stated as follows:

"The laws by which the states of physical systems undergo change are not affected, whether these changes of state be re-

ferred to the one or the other of two systems of co-ordinates in uniform translatory motion." [9]

This "principle of relativity" was suggested by the fact that the Michelson-Morley experiment (see p. 136), and other similar experiments, had failed to reveal any evidence for a motion of the earth with respect to the ether of space; and it is equivalent to the assumption that "it is of necessity impossible to determine absolute motion by any experiment whatsoever." [10] In other words, "The phenomena of nature will be the same to two observers who move with any uniform velocity whatever relative to each other"; for if there were any observable difference, this difference would enable us, in principle, to determine absolute motion, which by hypothesis is impossible.

Einstein is chiefly concerned with the bearing of these two principles—the principle of the constant velocity of light, and the principle of relativity—upon measurements that depend upon the transmission of light signals. From this point of view the two principles may be paraphrased, I think, as follows:

(1) The velocity of light, c, is unaltered by any motion of the observer with respect to its source; and

(2) This constant velocity, c, is also unaltered by any motion of the observer with respect to the ether (or to anything which might be supposed to be in a state of absolute rest).

Now if we limited ourselves to nineteenth-century ideas, these two principles would obviously be contradictory. And in order to remove the contradiction it becomes necessary to modify traditional ideas of length, mass, and time. This modification is effected by introducing a factor equal to $\sqrt{1 - v^2/c^2}$, in which c denotes the constant velocity of light and v the velocity of the moving object with respect to a certain frame of reference. In the present exposition we shall represent this factor by the letter r. If then we represent the length, mass, and time of a body which is at rest by l, m, and t, respectively, and the correspond-

[9] See Einstein, A., *et al.*, *The Principle of Relativity*, 1923, p. 41.

[10] Cf. Jeans, J. H., in *Encyclopedia Britannica*, Thirteenth Edition, article on *"Relativity."* This, it may be remarked, is one of the best *brief* expositions of the theory of relativity to be found anywhere.

ing properties of the same body when in motion by l', m', and t', we have the following equations:

$$l' = rl$$
$$m' = m/r$$
$$t' = rt.$$

Certain interesting consequences follow from these equations: (1) Suppose the velocity of the moving body with respect to the chosen frome of reference is equal to that of light. In this case $v = c$, and therefore $r = \sqrt{1 - v^2/c^2} = 0$; consequently (if the body is moving in the direction of its length, l) it follows that l' becomes 0. Also m' becomes infinite, and t' becomes 0. (2) Suppose the speed of the moving body to be 0; that is, the body is at rest. In this case r becomes unity, and consequently $l' = l$, etc. (3) Suppose that v is any ordinary velocity; as, for example, a mile a minute. In this case the value of r would be so nearly the same as in Case (2) that for all practical purposes the two cases would be indistinguishable. (4) Suppose, however, that v is a little more than 161,000 miles per second. (The velocity of light, c, is, it will be recalled, about 186,000 miles per second.) In this case v^2/c^2 is approximately .75, and the value of r is about .5. It follows that a body moving relatively to a certain frame of reference with a speed of 161,000 miles a second is only about half as long (in the direction of its motion) as the same body when at rest; but the mass of such a body is approximately twice as great as when it is at rest; while the associated time is about half as great. (By "associated time" we mean the lapse of time as indicated by a clock which is assumed to be traveling with the moving body.) [11]

The form of the theory of relativity which we have been expounding is known as the "special relativity theory." It is so called because it applies only to the case of bodies which are in uniform motion of translation with respect to each other or to

[11] In each case we should perhaps say "appears to be" rather than "is"; for these changes would not appear save to an observer with respect to whose frame of reference the body is moving with the velocity in question. (See p. 147.)

the observer. In other words, there is in their case no change either in the rate or the direction of their motion. This would of course exclude from the purview of the special theory all cases of motion of rotation or of revolution. The removal of this restriction leads to what is called the "general theory of relativity." The most important implication of the general theory is that gravitation is in all respects indistinguishable from an acceleration; and that the curvature which is responsible for the acceleration which is gravitation is not a curvature in ordinary Euclidean space, but rather, as we have seen (Chap. III, p. 77), a curvature of four-dimensional space-time in a fifth dimension. And it has been suggested indeed, by Weyl and others, that not only gravitation but all so-called "forces" may be accounted for in terms of the metrical properties of space-time.[12]

Relativity and Subjectivism.—It is, I think, a mistake to suppose that the theory of relativity denies, or implies a denial of, the existence of an objective reality. It must be admitted, however, that much which has been supposed to be objective is simply the product of our mundane, human way of thinking.

To appreciate the significance of this problem, let us recall our distinction between "primary" and "secondary" qualities. (Chap. IV, p. 92.) It will be remembered that the qualities which are traditionally called "primary" are the mechanical or spatio-temporal properties of things, such as size, shape, mass, texture, motion, and the like. These are said to be objective, because they are qualities not only of our idea but of that which is the object of the idea. On the other hand, properties like taste, odor, temperature, color, etc., have been called "secondary" for the reason that they have not been assumed to be qualities of the object but only of the *idea* of the object.

Now the reason for giving the properties of color, temperature, etc., only this secondary sort of reality has usually been that they depend upon the special condition, position, or point of

[12] According to current newspaper reports (January, 1929), Einstein himself has now completed a mathematical demonstration of the identity of electromagnetic force with gravitation.

view of the observer. But this is almost exactly what the theory of relativity now says about the so-called "primary" or spatio-temporal qualities. Shall we say, then, that size, shape, motion, etc., are also secondary and merely subjective? There is a sense in which this may be justified; but unless there is a good deal of explanation, this form of statement is likely to be highly misleading.

For, in the first place, if everything is called "subjective," there is no longer any reason for calling anything "subjective." "Subjective" and "objective," indeed, are correlative terms, like "tall" and "short," or "rich" and "poor." If all people were tall, we should never think of saying that anybody is "tall." And if all were rich, we should never think of saying that anybody is "rich."

And in the second place, while it may be true, as is taught by the theory of relativity, that the spatial, temporal, and material properties of reality are relative to the motion and point of view of the observer, it does not follow that reality has no properties whatsoever which correspond to and condition the properties which things appear to have. Space and time may be different for each observer; but space-time is, according to the relativity hypothesis itself, the same for all.

The rather widespread impression that the theory of relativity implies a subjectivistic theory of knowledge is probably due to a hasty inference from the word "relativity" rather than to a consideration of the actual content of the theory of relativity. For, paradoxical as it may sound, this so-called theory of relativity might better be called *a theoretical pursuit of absolute fact;* that is to say, of fact or reality which is independent of the idiosyncrasy or point of view of any particular observer or group of observers.

The naïve man thinks of his universe, so far as he thinks of a universe at all, from the standpoint of an observer on the surface of the earth. The first step in sophistication is to place a hypothetical observer in the center of our solar system. Another step follows almost immediately, however; for it is realized

that the sun too, with all its attendant planets and satellites, is itself in motion. In order that this motion may be envisaged, the observer is now equipped with a frame of reference determined by the "fixed stars" or by the "ether" or by something else which is assumed to be in a state of absolute rest. The relativity theory, however, pronouncing any such assumed absolutely motionless frame of reference non-existent, sets out to find a description of reality which shall not presuppose any particular point of view, but which shall be true alike for all points of view. Thus the "principle of relativity" itself—the requirement that "every law of nature which holds good with respect to a co-ordinate system K must also hold good for any other system K' "—is a postulate of the objectivity of the natural order.

Or, as the case is put by Jeans:[13] "If the hypothesis of relativity is true, the same continuum and the same world lines will represent the history of the particles of the universe equally well for all observers, the influence of their motions being shown only through their choosing different axes of space and time. Thus the continuum must be thought of as something real and objective, but the choice of axes is subjective."

The same thought is expressed by Minkowski:[14] ". . . the word *relativity-postulate* . . . seems to me very feeble. Since the postulate comes to mean that only the four-dimensional world in space and time is given by phenomena, but that the projection in space and time may still be undertaken with a certain degree of freedom, I prefer to call it the *postulate of the absolute world* (or briefly, the world-postulate)."

6. Is Motion Absolute or Relative?

That motion is relative is a doctrine that long antedated the time of Einstein. To make clear just what is meant by the relativity of motion, let us employ a well-known illustration: Suppose a ship to be moving through the water at the rate of

[13] Jeans, J. H., "Relativity," in *Encyclopedia Britannica,* Thirteenth Edition.
[14] Einstein, A., *et al., The Principle of Relativity,* 1923, p. 83.

four miles an hour. Suppose also that a sailor is walking along the deck at the rate of four miles an hour, but in the opposite direction from that in which the ship is moving. Query: Is the sailor moving, or is he at rest? Obviously he is at rest with respect to the water, but in motion with respect to the ship. Moreover, the man, the ship, and the water are all moving with respect to the sun and the "fixed" stars.

In order to describe motions of this kind, then, it is always necessary to specify *that in reference to which* a given object is said to be in motion. And in saying that a certain object is at rest, precision requires that we specify that in reference to which it is at rest; for with respect to something else it may be in motion. This is what is meant by the theory that both motion and rest are relative concepts.

Our use of the term motion is comparable, then, to our use of the term riches. Here is a man who is "worth" $100,000. Is he rich or poor? Clearly the answer depends upon our standard of comparison. If you compare him with most of us, he is rich: if you compare him with John D. Rockefeller or Henry Ford, he is poor indeed. In the same way, in the phrase "moving body" the adjective "moving" is a relative term which has no meaning at all except by reference, either explicit or implicit, to some standard body.

Suppose now that in all this universe there were only *one* body. This might mean either that all the matter of the universe had been consolidated into one mass, or that there existed no matter at all but only the ether. In either case (if we abstract from the possibility of a motion of a part of the one body with respect to its other parts) it would be meaningless to speak of motion. Suppose, however, there were *two* bodies, either two material bodies and no ether, or one material body and the ether. In this case it would be meaningful to speak of motion; but it would be idle to dispute as to which was in motion. Thus if the two bodies in question were two lovers, A and B, and if, when they perceived that the distance between them was increasing, A should say to B, "Why are you leaving me?" B would

probably reply, "It is you who are leaving me." For the statements,

"B is moving and A is at rest,"
"A is moving and B is at rest,"
"Both A and B are moving away from each other,"

would simply be three ways of saying the same thing.

It must be admitted, indeed, that if there are assumed to be many bodies in the universe, several of which are at rest with respect to each other, the doctrine of the relativity of motion is not quite so obvious. For suppose the number of bodies to be ten, and suppose nine of them to be at rest with respect to each other, and the tenth to be moving with respect to these. In this case, it would no doubt be more convenient to forget all about our doctrine of relativity and to regard the nine as in a state of absolute rest and the tenth as in a condition of absolute motion. Or in a universe in which all bodies are in motion with respect to each other, it might be theoretically possible, whether convenient or not, to determine a frame of reference such that the total amount of motion of all the bodies of the universe with respect to it would be less than with respect to any other frame of reference whatsoever; and then to define absolute motion as motion with respect to this. In neither of these cases, however, would there be any reason to believe that the phenomena of nature would be observed any more truly from the frame of reference which was taken as the standard than from any other.

In other words, if we may parody a famous historical document, it is evident that *all frames of reference are created equal;* and this democratic equality of moving platforms, and of the points of view of differently placed observers, is the essence of the theory of relativity. For it is idle to speak of motion, length, or mass unless we specify a frame of reference.

Up to this point we have dealt only with what is known technically as "motion of translation"; that is to say, with motion in a straight line. As long as we confine ourselves to motions which are free from any change of direction, it is quite

satisfactory, as we have, I hope, made clear, to say that motion and rest are relative to the chosen "frame of reference." When we turn, however, from *translatory* motion to *rotational* motion, as exemplified by the spinning of a top, the turning of the earth on its axis, etc., the question is far from simple.

It is true, of course, that if we go back to our case of a universe containing only one body, and if we assume this one body to be perfectly rigid, it would be idle to inquire whether or not this body could rotate. To attribute rotation to a perfectly rigid solitary body would be a statement wholly devoid of meaning. Again, in the case of two such bodies, to say that A is rotating with reference to B, and to say that B is revolving about A, would be exactly equivalent statements, and it would be meaningless to dispute as to which would be the better.

When we come to deal however with complicated systems like our solar system, in which certain bodies which are rotating on their axes with respect to the stars are themselves revolving around a central body, and in turn have satellites revolving around them, the case for the relativity of motion is far from clear. For if we say that rotational motion is relative, both Copernicus and Ptolemy would be right. The earth would rotate with respect to the sun and the fixed stars; and it would be equally true to say that the latter revolve with respect to the earth. And certain difficulties arise, which may not be conclusive, but are too serious to be wholly ignored:

(a) As suggested in the preceding paragraph, the structure of the solar system is too complex to be looked at quite so simply. It is possible to get rid of rotation in the case of any one planet, but it is not possible, even in thought, to rid all the planets of rotation at the same time. For if we think of the earth as stationary and all else as revolving around it, it remains necessary to think of the other planets not only as *revolving* but also as *rotating* with respect to the earth.

(b) There are certain facts—as the bulging of the earth at the equator, the deviation of the pendulum and the gyroscope, the directions of winds and ocean-currents, etc.—all of which

appear to result from the earth's rotation. To relate these to the revolution of the stars with respect to a stationary earth involves us in serious complications; for it seems to be an indispensable postulate of physical science that the effect of exceedingly remote objects may safely be disregarded in formulating the laws of phenomena; and if this postulate be given up in relation to some phenomena—the shape of the earth, the tides, etc.—it must be given up in relation to all. The result would be to make physical science a thing of unmanageable complexity.

(c) There is also an obvious difficulty arising from a consideration of the relative masses involved. It is, I should think, more than a mere prejudice which leads us to prefer the rotation of one comparatively small mass to the revolution of a vast number of tremendously larger masses. This will appear even more clearly when the rotating bodies in question are smaller than the earth. Consider the case of a weight—for example, to take the famous illustration employed by Sir Isaac Newton, a vessel partly filled with water—which is suspended by a cord. We can set it spinning, and then whenever we choose we can set it going in the opposite direction. In doing this do we change the direction of revolution of the entire universe? If we hold that all motions are relative, we must grant this assumption. But "what would become of our laws of motion and our concepts of force, mass, and causality, if we believed that by a simple turn of the hand we could check a rapid angular revolution of the whole universe, except a pot of water, and throw it into an equally rapid revolution in the opposite direction?" [15]

(d) Finally there is a difficulty which arises from the relation of the distances and consequent velocities of the bodies in question to their masses, which, whatever may be thought of the preceding difficulties, seems to me to be insuperable. Suppose we assert that it is purely a question of a choice of phraseology whether we shall say that the earth turns on its axis once every twenty-four hours, or that the entire starry firmament revolves

[15] Burtt, E. A., *The Metaphysical Foundations of Modern Physical Science*, 1925, p. 252.

around the earth. We surely cannot ignore the fact that bodies whose distance from the earth must be expressed in terms of light-years would, according to the latter form of statement, be moving with velocities far in excess of that of light; and that, inasmuch as mass is found to increase with velocity (see p. 142) in accordance with the formula

$$m' = \frac{m}{\sqrt{1 - v^2/c^2}}$$

the mass of a body moving with such a tremendous velocity would be infinite.[16] In other words, it would seem to be impossible that bodies should move with such velocities; or, at any rate, that there would be any force capable of producing any change in their rate of motion. But to return to the example employed in the preceding paragraph—that of the rotating vessel of water—in reversing the motion of a rotating body we should be changing the rate of motion of a multitude of bodies, each one of which would have an infinite mass.

It may be well to remind ourselves that in this chapter we do not profess to be dealing with problems that have been solved, but rather with perplexities. It may be that *rectilinear* motion is relative, but that there is a sense in which *rotational* motion must be regarded as absolute. Or it may be that the difficulties of which we have been thinking will disappear when we no longer regard rotations as phenomena taking place in a space of three dimensions but as events in a world-order of many dimensions. In this connection it should be recalled that the curvature of path which produces the acceleration which we know as gravitation results from the warping of four-dimensional space-time in a higher dimension. (See p. 77.)

7. Can the Laws of Motion Be Explained?

As we pointed out in the preceding chapter (p. 124), the procedure and attitude of the sciences have been influenced by

[16] Or perhaps we should say that in this case the formula would become nonsensical; for the denominator of the fraction would be an imaginary quantity.

the example of geometry; and it is the essence of the geometrical method to give rigorous demonstrations wherever these are possible. Principles which cannot themselves be demonstrated, but which are needed in the demonstration of other principles, are presented as "axioms" or "postulates." But it is one of the fundamental postulates of the methodology of science that the number of unproved first principles should be as small as possible. There is, accordingly, great rejoicing among the devotees of pure science whenever some generalization is found of which previously underived principles may be shown to be logically necessary consequences.

Now whenever any fact or principle is thus shown to be a particular case of some more general principle, the fact or principle in question is said to have been "explained." And it is in this sense that we wish to inquire whether Newton's three laws of motion can be explained.

The celebrated French philosopher Poincaré points out[17] that Newton's laws of motion are empirical merely, and not necessary inferences from the nature of reality. In other words, they cannot be deduced by *a priori* reasoning, but are generalizations from experience. They are *hypotheses,* which have been retained because (as long as we limit our researches to ordinary velocities) they do not run counter to experience.

Indeed, in the case of the first law, the law of inertia, there are several possible formulations, each of which would, in advance of experience, be every whit as satisfactory from the standpoint of deductive logic as the one adopted by Newton. For example:

(a) A moving body not acted upon by any external force might gradually slow down and come to rest;

(b) It might move with a constant acceleration;

(c) It might move in a curve of uniform radius.

The first of these formulations happens to be the doctrine of Aristotle. And we know now that he was wrong. His formulation is wrong, however, not because it is unreasonable, but

[17] *Foundations of Science,* 1913, pp. 92 ff.

solely because it is not so serviceable as that of Newton in organizing the data of experience. Essentially the same is true of the other alternatives. They are not unreasonable; in advance of experience with moving objects it would be just as logical to suppose that, when not acted upon by anything else, they would move with gradually increasing velocity, and in a curve of uniform radius, as to suppose, in agreement with Newton, that they would move with uniform velocity in a straight line.

Empirical versus Rational Demonstration.—In order to appreciate fully the force of what we have been saying about the empirical character of Newton's laws, we may remind ourselves of a distinction which was discussed in the concluding paragraphs of Chapter IV. We recall that some principles, as for example the proposition that the square of the hypotenuse is equal to the sum of the squares of the other sides of a right triangle, may be established in two different ways. You may "prove" such a proposition *empirically* by measuring the sides of a great number of right triangles and showing that within the limits of probable error in measurement the relation of the squares holds in the case of every one of them. Or you may prove the proposition *rationally*, as is done in our traditional geometry, by showing that it follows with logical necessity from certain other theorems, which have been shown to follow with logical necessity from certain other theorems . . . and so on, until we come back at last to propositions which cannot be proved but must be presented as postulates.

Now the physicist would like it very much if all of his laws could be established in this second way, as well as in the first. This does not seem to be possible, however, in the case of the laws of motion, not at any rate in the form in which they have been stated by Newton. The second law, the law of acceleration, and the third law, the law of action and reaction, are indeed but corollaries and explications of the law of inertia. And this, as we have said, appears to be no more than an empirical generalization.

We might attempt, perhaps, to derive the law of inertia from

the law of the conservation of energy; but the obvious objection to this procedure is that conservation, instead of being a more general concept than inertia, is but another name for the same thing. Besides, the law of conservation itself (cf. Chap. IV, p. 93) is only an empirical generalization.

Again, if we accept the point of view of the theory of relativity, we may seek to explain all the motions of material particles in terms of the metrical properties of space-time. In this case, however, it seems necessary to postulate the principle that motion is always in the shortest path. And for this, in turn, no further reason can be given.

8. Are the "Higher" Sciences Deducible from the "Lower"?

The discussion of the previous section appears to have resolved itself, then, into the question which of three principles—the principle of inertia, the principle of conservation, or the principle of least distance—should be considered as fundamental to the others. If any one of these three is presented as a postulate, it may be that the others can then be rationally demonstrated.

Let us suppose, however, that we were in possession of an ideally complete kinematics; in other words, that all the laws of motion were fully known, and completely accounted for by reference to a few metrical properties of space-time, from which, as a set of postulates, they could be shown to follow by rigorous deductive reasoning. And by "laws of motion" I mean here not only the laws which "govern" the motions of visible masses at ordinary velocities, but also the laws of the motions of molecules, of atoms within the molecule, of electrons and protons within the atom, of free electrons in an electromagnetic field, and of any other motions whatsoever. This assumption having been granted, we are now confronted by the question whether such an ideally complete kinematics (or as we should say, I suppose, from the standpoint of the theory of relativity, such an ideally complete *chrono-geometry of space-time*) would not

be found to include the entire body of propositions which we call descriptive science. In other words, we are asking whether the so-called "higher sciences"—biology, psychology, sociology —require any postulates and indefinable concepts which are not required in physics and chemistry; and whether in turn these latter, the so-called "lower sciences," require any postulates and concepts which are not already required in mathematics.

Those who maintain the dogma of the unity of all science would hold, of course, that a complete knowledge of any one science would logically imply a knowledge of all. The denial of the dogma of the unity of science gives rise to the "theory of levels"; and, if the levels are thought of as appearing one after the other in time, to the "theory of emergence," or of "emergent evolution."

According to the theory of levels, then, as we pass from physics to chemistry, and from chemistry to biology, and from biology to psychology, and perhaps from psychology to sociology, in each case we meet something new and require new concepts and new postulates for its description and explanation. And if we think in terms of emergent evolution, we must recognize the appearance, at successive periods of time, of novelties, which did not exist even in germ in the preceding periods.

The issue thus presented between the conception of the *unity of science* and the conception of science as a succession of *levels* will confront us again when we shall have completed our survey of the achievements of biology and psychology. In the meantime, we may venture two remarks:

In the first place, the victory of the latter doctrine is too easily won to be of much value, if the question is discussed from the point of view of our present knowledge of the so-called lower levels. No one supposes, for example, that the principles of physics and chemistry, as now understood, are adequate to account for all the phenomena of life; or that the principles of biology, as now understood, are adequate to account for all the phenomena of mind. Nevertheless everyone, whether he be a partizan of *unity* or of *levels,* recognizes the importance of con-

tinuing research on the assumption that progress is still possible in this direction.

In the second place, if we admit the existence of levels, of chasms which can never be bridged but which will always have to be leaped over, in passing from one science to another, consistency seems to require the recognition of such levels or discontinuities *within* as well as *between* the various sciences. In other words, the same sort of reasoning which leads us to admit six or eight different levels of reality would apparently require us to recognize the existence of an indefinite number. And it is indeed a fair question whether there is not at least a *prima facie* discontinuity in every cause-effect and every part-whole relationship.

The Relation of Cause and Effect: Occasionalism.—The doctrine that such a discontinuity is to be found in many instances at least of the cause-effect and part-whole relationship may be called "situationism," or, at some risk of misunderstanding, "occasionalism." In agreement with the theory of levels or of emergence, situationism, or occasionalism repudiates the alleged axiom that "there can be no more in the effect than there was in the cause," or, as sometimes put, that "no stream can rise higher than its source." We may then suggest the following account of the cause-effect relationship:

The occurrence of the event or group of events which we call "the cause" is the signal or the occasion for the occurrence of the event or group of events which we call "the effect"; and the former may or may not be similar to the latter, and may or may not include or imply it.

In other words, if the cause is thought of as one situation, and the effect as another, all that we can certainly mean when we say that one is cause and the other effect, is that as a matter of fact in our experience of reality, the former situation has always or nearly always been succeeded by the latter. It is then misleading to assimilate the relation of cause and effect to that between the premises and the conclusion of a syllogism, or between the definition and the properties of a geometrical figure,

such for example as a triangle. If then we were confronted with an entirely new situation, we could not tell by any process of *a priori* reasoning what to expect next; we could only "wait and see."

What has been said about the relation of the cause to the effect may also be said about the relation of the parts to the whole which is constituted by them. The relation of the protons and electrons to the atom, and of the atoms to the molecule (cf. Chap. IV, pp. 101 ff.) is characteristic of all instances of the part-whole relationship. The properties of the whole are not simply the sum of the properties of its parts. Wholes have properties which are not properties of their parts. In a word, a whole is always *more* than the sum of its parts.[18] It follows that no matter how complete might be our knowledge of the elements or constituents, considered separately, we could not tell by any process of *a priori* reasoning what their properties would be in combination; but could, again, only "wait and see."

It is obvious that, if this view of causation be true, it will never be possible to derive all of the propositions included in descriptive science from the comparatively small number of postulates required for even an ideally complete science of motion. And as we pass from the lower to the higher sciences, we shall need new postulates and new concepts, or if we wish to think in terms of mathematics, new dimensions of space-time.

In conclusion, it may be desirable, in order to guard against a possible misunderstanding, to offer two remarks concerning the relation of the "occasionalism" which we have expounded in the preceding paragraphs to the "occasionalism" of the followers of Descartes, which we shall touch upon in Chapter XI, under the head of "dualism." In brief, our occasionalism may be thought of as a generalization of the older doctrine. The problem which exercised the Cartesians was the explanation of the interaction, or as they would have said, the *apparent* interaction of mind and body; for us the mind-body problem is only a special case under the head of interaction in general. Again, the Car-

[18] There may, however, be *aggregates* which are not wholes. (See p. 421.)

tesians attempted to solve the problem of interaction, or apparent interaction, by referring it to the activity of the divine will; and according to our point of view, which might therefore be called *naturalistic occasionalism,* the arrival of the effect upon the occasion of the situation which we call its cause is simply regarded as a fact of experience, for which no further explanation is offered.

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CHAPTER VI

BIOLOGY AND PSYCHOLOGY—ACHIEVEMENTS

1. The Classification of Plants and Animals

If we should try to study and remember the characteristics of all plants and animals as individuals, we should not get very far with our undertaking. Long experience, however, has encouraged us to believe that individuals which resemble each other in numerous ways will be found to resemble each other in many additional respects. No *a priori* reason can be given why this should be so, and the expectation is now and then disappointed; nevertheless our world appears to be the sort of world in which, *as a rule,* resemblance may safely be taken as an index of further resemblance. (Cf. Chap. X.) Indeed all classification is thus based upon resemblance, or as we say in logic, upon "analogy." We have reason to believe that individuals which have certain important points of similarity may for many purposes be dealt with in the same way. Accordingly, individuals which may be lifted, so to speak, by the same handle are said to belong to the same class.

Now it is obvious that there are degrees of resemblance. Individual plants and animals between which there are no important points of difference, except in spatial and temporal relations, are said to belong to the same "variety." Where there are numerous points of resemblance together with certain outstanding points of difference, they belong, not indeed to the same variety, but to the same "species." And where there is still less resemblance and still more difference, we speak of common membership in a "genus," and so on. Thus a variety includes a multitude of individuals; a species may include several varieties; a genus

several species; a "family" several genera; an "order" several families.

It is important to observe that the terms "genus" and "species" are sometimes employed in a somewhat different sense. If any two classes are so related that one of them includes the other and more besides, the broader of the two is called the genus and the other the species. Thus what we in the preceding paragraph called the species would be the genus with respect to the variety; and what we called the genus would be the species with respect to its family; while the family, in turn, would be the genus with respect to the genera which it includes, but a species with respect to the order of which it is a subdivision.

It is this latter sense in which these terms are used in logic. This is also the older, the more original, the etymological sense; for of any two classes, one of which falls within the other, the higher, broader, or more *general* class is the *genus;* and the lower, narrower, more *specific* class is the *species.* In zoölogy and botany, however, the terms genus and species are given an absolute meaning as the names for certain definite levels in the classification. This has turned out to be somewhat unfortunate, however, as in the controversy over evolution a factitious importance has been assigned in certain quarters to the difference between a variety and a species.

2. The Discovery of Microscopic Plants and Animals

Before we turn, however, to a consideration of the unification of the multifarious realm of life which is achieved for us by the theory of evolution, let us realize as well as we can the unimaginable diversity of vegetative and animate forms.

For the world is, so to speak, far more densely populated than anyone, even the boldest, would have dared to suppose a few centuries ago. In addition to the uncounted multitude of obviously visible plants and animals there is another uncounted multitude of living things which are too small to be seen by the naked eye. The microscope, like the telescope, has revealed to the startled eye of man a new realm of being; and vastly in-

creased the extent of that "synoptic vision" which is sought by the philosopher.

Every child is now acquainted with the idea that many diseases are caused by "germs" of one sort or another, and that these "germs" are simply tiny animals and plants. It is a matter of common knowledge, too, that fermentation and decay do not take place in the absence of certain micro-organisms; and that if these are destroyed and excluded, fruit and other food will "keep" indefinitely.[1] It must not be supposed, however, that all forms of microscopic life are harmful to us. On the contrary, many micro-organisms—as, for example, those employed in making cheese—are beneficial.

The Cell.—Not only has the microscope forced us to recognize the existence of a vast number of independent species of plants and animals, but it has also revealed the surprising fact that all plants and animals are composed of structural units which are in many respects analogous to some of the simplest forms which have been found to have independent existence. Each of these structural units is called a *cell*. Some lowly plants and animals consist of but one cell, and are therefore said to be unicellular; the vast majority of species, however, are multicellular, that is to say, many-celled.

Thus a man is composed of thousands of millions of cells. In other words, there are more cells in each of our bodies than there are men, women, and children in the whole world. Perhaps, then, every individual cell has its own private life and consciousness in addition to its share in the corporate life of the organism. Perhaps each cell has its own joys and sorrows; its own hopes and fears and aspirations. Perhaps, when the white blood-cells go forth to war, to fight and die to protect us against the invasion of hostile bacteria, they are consciously inspired by a sentiment of loyalty to the body of which they are a part. But this is only a curious speculation, which we have no way of

[1] This statement may not be wholly accurate. I am told that there are certain enzymes which reduce the structure of perfectly sterile pieces of muscle in a manner analogous to that of micro-organisms.

either proving or disproving. And the speculation may be carried also in the reverse direction. Perhaps each of us, in turn, is but a cell in a far larger corporate being, which may know and care no more about us than we know and care about the cells of our bodies!

By some thinkers, our relation to the nation of which we are citizens has been likened to that of the cells to the entire body; but it seems clear that the life of the individual cell is much more completely subordinated to that of the organism than is the life of the individual man or woman to that of the body politic. In a community of ants or bees, however, there would appear to be a close analogy to the community of cells in the organism.

3. The Theory of Evolution: Biogenesis, Transformism

In an earlier paragraph we tried to explain the use of the terms *variety, species, genus,* etc., in a biological classification. The theory of evolution or "transformism" may best be approached by raising the question of the origin of varieties. As the word itself suggests, a variety is a *variation.* The theory underlying the name is that all the varieties included in a given species are to be considered modifications or variants of this species. All the varieties may be supposed to be descended from a common ancestor or ancestral pair. This was conceded even by pre-Darwinian biologists. When they came to think of the species, however, the case was supposed to be different. The varieties were indeed variations of the species; but the possibility of variation was held to be very sharply limited. Variation, it was maintained, could never proceed so far as to produce an actual change of species. Each species was believed to have been separately created, and to have remained essentially unchanged from the day of its origin to the present. The very title of Darwin's epoch-making book suggests the rival hypothesis. The essence of Darwin's theory is found in the contention that the *origin of species* is in principle the same as the *origin of varieties.*

The Argument for Transformism.—There are then two rival hypotheses between which we may choose. One is the hypothesis of separate or special creation; the other is the hypothesis of variation and natural descent. A complete discussion of the issue would be out of place here, but a brief outline of the argument by which the scientific world has been led to accept the theory of transformism may be in order. We may divide it into five principal divisions. These are as follows:

(1) The Argument from Comparative Anatomy.—If you see two men who look very, very much alike, your first thought is that perhaps they are twins. If the resemblance is not quite so close we wonder whether they are brothers or cousins. In a word, physical resemblance is assumed to be an indication of a common ancestry. Now when various species of plants or animals are compared, certain fundamental similarities become manifest. In fact it was on account of such similarities that species were long ago grouped under their respective genera. It is natural to ask whether all the species of a given genus may not have had a common origin. The same question arises for all the genera of a given family, and so on until we are moved to inquire whether all life may not be one.

It is important to observe, however, that the argument from comparative anatomy, even when it is reinforced by quite recent discoveries of degrees of similarity in the constitution of the blood of certain species, is not sufficient, if it stands alone, to justify a decision between the two hypotheses. The defender of the hypothesis of special creation might maintain that the Creator had simply carried the same idea through a larger or smaller number of distinct creations. In this way an architect may employ the same general plan in designing a number of different houses.

(2) The Argument from Paleontology.—It has been found, however, in reading the story of the past which is contained in the rocks, that in some cases it is possible to arrange a fairly complete series of fossil remains so as to lead from some

early form of life to a later form of life which is quite different from it. The successive links in the chain are so similar as to compel the belief that the relation is that of natural descent. Thus by a series of gradations, each of which is so small as to indicate natural descent, we are led from one form to another of a quite diverse kind. The most famous series of this kind is that connecting the "eohippus" with our modern horse. Here again, however, if the argument from fossils stood alone, it would not be sufficient to produce conviction; but taken together with the argument from the resemblances among species now living, it creates a very strong presumption in favor of transformism.

(3) The Argument from Embryology.—The presumption created by the preceding arguments is powerfully reinforced by the argument from *embryology*. Careful study of the embryos of men and animals reveals two facts of prime importance from our present point of view. In the first place, the farther back we go in the period of gestation, the greater becomes the similarity between species which the evolutionist supposes to be akin. This supports the argument from comparative anatomy. In the second place, the embryo is found to pass through stages roughly corresponding to those through which the species must have passed if the evolutionary theory is true. Thus the human embryo is said to develop "gill slits," and a well-marked tail, and a greater number of ribs than the adult man possesses. On the hypothesis of special creation there is no reason for this "recapitulation." On the hypothesis of transformism it seems quite natural.

(4) The Argument from Vestigial Organs.—Not only the embryo, but the adult organism as well, bears traces of the path over which the species has come. Speaking in particular of man, there are certain vestiges, as they are called, which are more simply explained on the hypothesis of transformism. The most notorious is, of course, the vermiform appendix. On the hypothesis of special creation, these vestiges are utterly inexplicable; but on the evolutionary hypothesis they may be

accounted for as relics of organs which were functional in man's remote ancestors.

(5) Geographical Distribution.—When a comparison is made of the fauna and flora of various parts of the world, it is found that the species are similar if there are no barriers between the countries in question. But where intervening barriers are found, such as high mountain chains, deserts, or oceans, the species are quite diverse. For example, Australia was found to have a very large number of species which exist nowhere else; although the genera to which these species belong are all represented elsewhere. On the hypothesis of transformism, this state of affairs is explained on the ground that the separation of Australia from the remaining land-masses was so early in geological time that new species have arisen there which have had no opportunity to make their way to other parts of the world. But on the hypothesis of special creation, why should the Creator have chosen to stock Australia and similar detached regions with such peculiar animals and plants?

Is Evolution Unscriptural?—If we consider transformism and special creation as two rival hypotheses between which we are to make a decision in the same spirit in which we should choose between two theories, let us say, of light or of sound, there is little doubt as to our decision. While no one of the foregoing lines of argument is absolutely conclusive if taken by itself, when all are taken together their cumulative force is so great as to make out a very convincing case. The difficulty for many people, however, is that they do not approach the question in this unbiased spirit. They do not think of both views as *hypotheses*. For them evolution is a hypothesis, while the special creation idea is a divinely accredited doctrine. It is essentially the same situation as prevailed when the Copernican astronomy was the subject of discussion. This, too, was thought at first to be contrary to scripture. Religious people long ago learned to regard the new astronomy as perfectly compatible with a high regard for the Bible. In the same way they will learn before long to read their Bibles for ethical and religious

inspiration—and also to appreciate the accredited results of biology. There is no more reason for retaining the *biology* of the Bible than for retaining its *astronomy*.

Evolutionism and Mechanism.—In the importance of the theological and ethical implications which follow, or seem to follow from it, the theory of evolution is comparable only to the Copernican theory of the solar system. The theory of evolution gives us unity and continuity within the realm of biological organisms. Thus it reinforces the tendency toward a naturalistic or mechanistic view of the world. It was in biology that teleology seemed to have its inexpugnable citadel. In pre-Darwinian days the advocates of the teleological theory could point to all the wonderful "adaptations" found in plants and animals. There, for example, was the human eye, with its complex arrangements, all contributing toward the function which it is designed to perform. It could not have merely happened, or been produced by merely natural forces. It must have been conceived and created by an intelligent agent. In the same way, it was maintained, the instincts of animals, the arrangements by which bees and flowers coöperate, etc., etc., were evidences of an intelligent architect of the world. This was known as the "argument from design," or the physico-teleological argument for the existence of God. And, though it had been severely criticized by Kant, it was still very influential. The theory of evolution, however, cuts the ground from under the argument from design. In variation and natural selection it finds a sufficient explanation of adaptation, without falling back upon a teleological explanation. The evolutionist says that for some reason, which we are as yet unable to understand (see pp. 191 ff.), variations appear. Some of these increase the individual's chance in the struggle for existence; others may be a handicap to him. The individuals in which very unfortunate variations or mutations appear will be eliminated in the struggle for existence, and these new traits will perish with them. Those individuals, on the other hand, in which the fortunate variations or mutations appear will have an advantage over the older types, and, if the struggle is suf-

ficiently intense, will eventually displace them. Thus, given sufficient time—and geology allows ample time—any "adaptation" whatsoever can be explained. It is not necessary to assume that there was a prior *plan.*

From the standpoint of the evolutionist, the argument of the teleologist is analogous to that of the man who says, "Isn't it wonderful that every large city has a river right beside it or flowing through it? Surely this is evidence of design! The river was put there to serve the needs of the city." We should say to such a one, "The river was there first, and the city was built where it is because of the river." In the same way the teleologist used to say, "Isn't it wonderful that all existing plants and animals show a remarkable degree of adaptation to their environment? This is evidence that the world was made according to a plan." To this the evolutionist replies, "The relation is just the reverse of that supposed by the teleologist. Unless organisms were at least tolerably well adapted to their environment, they could not exist; and if the environment had been different, a different set of organisms would have survived to inhabit it."

Evolution and the Problem of Evil.—The most serious objection to the special creation hypothesis arises, however, from a consideration of the presence of evil in the world. In particular, what account can the special creation hypothesis give of the origin of disease germs? Can we really suppose that God deliberately made the micro-organisms which produce pneumonia and infantile paralysis and bubonic plague and cerebro-spinal meningitis, and all the other horrid and loathsome diseases which play havoc with the flower of the human race?

If, in order to avoid the difficulty arising from the existence of so many species of pathogenic bacteria, we suggest that they were not originally pathogenic, we admit the radical modifiability of species, and thus *in principle* accept the transformist point of view. For if we admit that noxious species have arisen by natural descent, how can we deny that other species may have arisen in the same manner?

4. The Mechanism of Heredity

One result of the point of view fostered by the theory of evolution has been to increase the range and significance of *experiment* in biology. For if all living things are, so to speak, blood relatives of one another, there is reason to believe that principles of heredity, nutrition, infection and immunity, adaptive behavior and learning, work and rest, etc., which are found to be true of one form of life will be true of many others. Thus, when it is impossible or inconvenient to experiment on man, it may be worth while to experiment upon our lowly cousin, the white rat, or even upon our far more distant relatives, the fruit-fly, the grasshopper, the pea, the primrose, and the snapdragon!

In the next section we shall summarize the results of recent research on the principles of nutrition. In the present section we shall present a few of the more securely established principles of heredity.

If two varieties of garden peas, one tall and the other dwarf, are crossed, one would naturally expect the resulting hybrids to have a stature intermediate between that of the parent stocks. In the classic experiment of Mendel, however, this was not found to be the case; instead, the first generation of hybrids were at least as tall as the tall parent variety. It might have been supposed, indeed, that the hybrids had derived nothing at all from the dwarf parent; but a continuation of the experiment showed that this supposition would also have been erroneous. For this first generation of hybrids produced offspring *one-fourth of which were short*. Thus the trait of shortness, having skipped a generation, reappeared in the second generation of hybrids.

Several points are suggested by this experiment, which in essence has been repeated by many experimenters, working with the same and many other species of plants and also of animals. In the first place, we are confronted by the conception of "unit characters." As the term is used in Mendelian litera-

ture, a "unit character" is a trait of a parent or other ancestor which either appears *as a whole* in the offspring or else is completely lacking. In other words, an "all or none" law holds in the case of such traits. The Mendelians do not maintain, however, that all characters are inherited in this fashion; but simply that there are many cases of this type of inheritance, and that by a study of such cases principles may be discovered which operate even when there is a blending of some of the parental traits in the offspring.

Another idea suggested by such experimental data is that of "dominance." Thus the trait of tallness is a *dominant,* and that of shortness a *recessive.* Consequently, in the first generation of hybrids, although the plants have received *determiners* for both tallness and shortness, the latter trait does not appear; for it is completely masked by the former.

The entities to which we have referred in passing as "determiners" have also been called "ids," "factors," or "genes." And it is believed by most contemporary biologists that these *genes,* as we shall now call them, are carried for the most part by that portion of the reproductive cell which, because it stains readily, is known as "chromatin." In a certain stage of the development of the cell the chromatin breaks up into small bodies known as "chromosomes" (literally "colored bodies"). These chromosomes are believed to contain the genes, which may be thought of as the vehicles of hereditary traits.

If we then translate Mendel's conclusions into twentieth-century terminology, they may be expressed in the form of two laws, which are called by Morgan [2] "the law of the segregation of the genes" and "the law of the independent assortment of the genes."

The first of these, the *law of segregation,* is the principle that genes of opposite tendency (as, for example, those for tallness and shortness) which are present in the same individual and transmissible to its offspring, do not modify each other but retain their original potencies. Further experimentation

[2] Morgan, T. H., *The Physical Basis of Heredity,* 1919.

shows this to be true even in the case of hybrids in which neither tendency dominates over the other, and in which the resulting trait is therefore a blend of the parental traits.

According to the other of the two laws, the *law of independent assortment,* when there are two or more pairs of genes of opposite tendency, it is entirely a matter of chance (except in cases where there is a linkage of genes) what combination of genes will be contained in a given ovum or a given spermatozoön. For example, "If a tall race of peas with colored flowers is crossed to a short race with white flowers, the offspring show the two dominant characters, *i.e.* they are tall and have colored flowers. If these are inbred they produce tall and short offspring in a ratio of 3:1, and these same individuals, if reclassified for pigment, are colored or white in the ratio of 3:1." [3] The explanation of this ratio for both pairs of contrasted traits—a ratio which is remarkably constant if we consider the results of a great number of experiments—is of course that there is a chance combination of genes. Thus assuming the law of segregation and the law of independent or random assortment, the first generation of hybrids would have four kinds of germ-cells. The first of these would contain genes for tallness and color; the second genes for tallness and white; the third for shortness and color; and the fourth for shortness and white. There would thus be four kinds of pollen grains and also four kinds of eggs; and in fertilization there would obviously be sixteen possible combinations, which, since we are dealing with random combinations, would, in a sufficiently great number of cases, be exemplified an equal number of times. As a consequence, twelve plants would be tall and twelve plants (but not the same twelve) would be colored; while four plants would be short and four (but not the same four) would be white.

That such a random assortment takes place is rendered highly probable by a study of the process of "maturation" by which the germ cells are prepared for that union of ovum and spermatozoön which is known as "fertilization." Every cell of a

[3] *Ibid.,* p. 59.

given individual contains a certain number (depending on the species) of chromosomes. Now, if in fertilization there were simply a union of all the chromosomes of the sperm cell with all the chromosomes of the egg, there would obviously be twice as many chromosomes in the resulting fertilized ovum as in the normal cell. Accordingly, in preparation for fertilization, each cell goes through a process of reduction by which half of its chromosomes are thrown off in what are called the "polar bodies." But which ones are rejected in a given case, and which retained, may well be believed to be a chance affair. If this is the case, it is clear that we have discovered the physical mechanism for the law of independent assortment.

Recent students of heredity find it necessary to postulate additional "laws" in order to take care of all the observed phenomena of inheritance. Thus Morgan enumerates four other principles besides those of segregation and independent assortment. These are the principles of "linkage," of the "linear order of the genes," of "interference," and of the "limitation of the linkage groups." A discussion of these additional laws of heredity would be too intricate to be included in this survey. Suffice it to say that they may all be characterized as qualifications and modifications of the law of independent assortment. What is of chief interest to us as students of philosophy is to observe that a good beginning has been made by the experimental biologists in their endeavor to explain the phenomena of life as physico-chemical properties of living matter.

Whether they can ever hope to give us a *complete* explanation of these phenomena is another question, to which we shall return in the next chapter.

5. The Principles of Growth and Nutrition

No matter how great the complexity of the organism in its adult stage, it results from a process of division and repeated subdivision of one original undifferentiated cell. In the case of all the higher animals this original cell is formed by the union of two parent cells. The various "tissues," that is to say, groups

of cells having a common specialized function, arise in the course of embryological development. However unwilling some of us may be to admit an evolution of the human species, a process of development must be granted in the case of each *individual*. For the embryo of man, no less than that of the so-called "lower animals," is found to pass through successive stages. It is first a "morula," then a "blastula," then a "gastrula."

As students of philosophy, however, we are less interested in tracing the successive stages in the development of the embryo, or in describing the details of the anatomical structure of the adult, than in the explanation of growth and nutrition in terms of the concepts and principles of physics and chemistry.

First of all, then, we are impressed with the fact that the biologist postulates the principle of *conservation*. A living organism is not able to produce within itself either energy or matter. On the contrary, it is utterly dependent upon its environment for the means of life, growth, and repair. Indeed, the energy required to operate the physico-chemical apparatus which we call the individual (human or animal) organism is produced in essentially the same manner in which energy is made available in a steam-engine; that is, through the oxidation of carbon, hydrogen, and their compounds. The organism must, accordingly, have a continuous supply of oxygen, and also a sufficient supply of fuel and building material.

Under all ordinary conditions the oxygen requirement presents no difficulty. The providing of sufficient fuel and building material is not always so easy.

The first thing to be considered in planning to meet the food requirements of the organism is that it shall be sufficient in quantity to produce the needed amount of energy. And the second desideratum is that it shall contain the proper proportion and amount of all the elements required for growth and maintenance. There must be not only a sufficient ration but also a balanced ration. In addition to water and various inorganic substances, it is necessary to see to it that the ration contains

the correct proportions of the proteins, the carbohydrates, and the fats.[4]

Until two or three decades ago, this was about the sum-total of our knowledge of the food requirements of the organism. Another exceedingly important advance in the science of nutrition was made, however, with the discovery of the substances known as "vitamines."

There are at least five of these, which are known as "A," "B," "C," "D," and "E," the letters having been assigned in the order of discovery. They have been discovered by feeding experiments, which prove that, although a diet may meet all the requirements of a balanced ration, having due proportions of protein, carbohydrates, and fat, and being sufficient to produce the needed number of calories of energy, growth is impeded, health destroyed, and certain characteristic diseases produced if the vitamines are lacking. Little or nothing is known of the chemical composition of the vitamines, or of the way in which they produce their effects; but it is believed by some investigators that they belong to the class of substances known as "enzymes," or still more generally, as "catalysts."

Catalysts have the property of promoting a reaction in which they themselves are not consumed; and *enzymes* are catalysts which are involved in vital processes. It has been suggested that the "genes," which we discussed in the preceding section as the determiners of heredity, are enzymes; and the same may be true of the "hormones" produced by the endocrine glands, which are now known to exert a controlling influence upon many vital processes. Consequently, there is much to be said in favor of the speculation that life in general is essentially a form of *catalysis;*[5] and that when the chemist succeeds in analyzing the catalysts (including the enzymes), and in producing them by artificial synthesis, he will be in possession of the secret of life.

[4] That is, the proteins cannot be reduced beyond a certain minimum if the animal is to be kept in nitrogen equilibrium.

[5] Specifically, of *auto*catalysis; that is, a reaction the product of which is qualitatively identical with the catalyst that promotes it.

6. The Relation of Mental Activity to Processes in the Physical Organism

The tendency of present-day biology is, then, to consider the individual organism as a physico-chemical mechanism. And this is true even in the case of man. It may be objected, however, that while the vital processes—digestion, assimilation, respiration, growth, reproduction, etc.—may be regarded in this manner, there are, at least in the case of man, certain processes of a different order which can be accounted for only as the manifestations of mind.

In view of this objection, it is important that we should appreciate the significance of the reasons which lead contemporary biologists and psychologists to believe that, mental activity in all its forms is very closely bound up with the processes of the physical organism. And first of all, it is important that we should recognize the intimate correlation of consciousness with the functioning of the nervous system.

The unsophisticated person[6] is likely to think of "mind" and "body" as two distinct entities, each capable of acting with some degree of independence. Or if, with increasing sophistication, we give up the idea of two distinct entities or substances, we may be inclined to think of two series of separate and dissimilar processes. Most contemporary psychologists find ground for maintaining, however, that there is no mental activity without an accompanying bodily activity; and that the bodily activity which is most closely bound up with manifestations of mind is change within the nervous system and in particular within that part of the nervous system which is called the brain.

A little later we shall deal with the suggestions (see Chap. VII) that a mental event and a physical event are perhaps one and the same thing, or two different aspects of the same thing, or more and less of the same kind of thing, etc. Let us now assume, however, for the sake of the argument, that mental

[6] We do not mean to suggest that all who maintain this doctrine are unsophisticated!

and physical events are two distinct kinds of entities. On this assumption, the psychologist's conviction of their close interconnection may be expressed in the well-known maxim, "No psychosis without a corresponding neurosis." *Psychosis* here means, of course, a mental or psychic event; while *neurosis* means the corresponding change in the nervous system. If this maxim be universally valid, there can be no such thing as "pure thought" if by that we mean thought which is independent of the functioning of the physical organism; neither would there appear to be any possibility of "discarnate intelligences," or "purely spiritual beings," unhampered by these tenements of clay which we call our bodies.

There are two main arguments for the principle of the correlation of consciousness with the nervous system. One may be called the argument from individual behavior; the other the argument from genetics.

(a) The Argument from Individual Behavior.—A sharp blow on the head is likely to make a person unconscious. Toxic substances, such as alcohol, if present in sufficient quantity, interfere with mental processes. A person cannot think well when he is physically tired. Mental defects have been found, in many cases where autopsies were performed, to have been accompanied by lesions or degenerative changes in the brain; and particular kinds of defects have been found to be correlated with particular locations of cerebral injury. Now if mind did not depend upon the integrity of the nervous system, such facts would be without explanation.

(b) The Argument from Genetics.—If we compare the structure of the various species of animals as we come up the scale of living forms from the protozoa to man, we find that each advance in intelligent behavior is matched by a corresponding increase in the complexity of the nervous system. In the amoeba, there is no differentiation of structure, the one cell serving all purposes in so far as they are served; and correspondingly, if we speak of amoeboid consciousness at all, it must be extremely simple. On the other hand, animals in

which differentiation of structure has been carried to a point of great complexity, and in particular such as have complex nervous structures, appear also to have a considerable degree of intelligence.

Furthermore, the physical development of the various species, that is to say, their evolution, is paralleled as we have seen by the development of the individual. And it is clear, and especially clear in the case of man, that the various mental powers appear in accordance with the ripening of the physical organism. Again, in the evening of life when brain weight decreases and the entire body begins to weaken, the mind also loses its force and we frequently find what is known as a "second childhood."

The Measurement of Reaction-Time.—An interesting sidelight is thrown upon the conception of the interrelatedness of consciousness and the nervous system by the success of the laboratory psychologists in measuring the time required for various reactions in different individuals. One of the commonest examples of such a reaction is the sudden withdrawal of the hand when it accidentally comes in contact with a hot surface. Another is winking when something is seen to threaten the eye. There is an old story of a blacksmith who discharged his apprentice because the latter was too slow. "He was too slow to wink quickly, and was always getting sparks in his eyes." Now the reaction-time, that is, the interval which elapses between the occurrence of the stimulus and that of the response, is actually found to vary from individual to individual. It varies also in the case of the same individual from time to time. Practice tends to shorten it, and it is shorter for some kinds of responses than for others.

The quickest of all the reactions are those known as "reflexes." Thus the "lid reflex," *i.e.* the wink in response to anything touching the eyeball or in response to an object suddenly approaching the eye, requires about five-hundredths of a second. "The knee jerk, or patellar reflex, aroused by a blow on the patellar tendon just below the knee when the knee is bent and the lower leg hanging freely, is quicker still, taking about three-

hundredths of a second."[7] On the other hand, the time required for a reaction involving *choice* is about twenty-five hundredths to twenty-eight hundredths of a second, depending upon the stimulus; while a reaction involving a minimal amount of *thought* takes about a tenth of a second longer still.

Why should time be required for the response to take place, and why should it be longer for "choice reactions" and "associative reactions" than for the "reflexes"? The only reasonable answer is that time is consumed in the journey of the nervous impulse from the sense-organ to the spinal cord or brain and then to the muscles which must contract to produce the response; and that in the choice and associative reactions the path over which the impulse travels is longer and more complex, and the time required correspondingly greater.

The Nature of the Nervous Impulse.—There has been considerable speculation as to the nature of this "impulse." A very old theory regarded it as the motion of a fluid through a hollow tube. There is, however, no reason to think that the nerve fibers are hollow; and even if they were, the velocity of the movement is too rapid to be that of a fluid. A more recent theory is that the nervous impulse or "current," as it is sometimes rather hastily called, is a current of electricity. The difficulty with this theory is that the rate of propagation is too slow. The most satisfactory theory appears to be that the disturbance which passes over the nerve fibers, and the passage of which requires *time,* is a progressive chemical reaction, accompanied by electrical currents. Although the analogy must not be pressed too far, it may be supposed to travel along the nerve fiber in much the same way in which fire travels along a train of powder. An alternative view, which should not be too lightly dismissed, is that the nervous impulse is a vibration of the particles of which the fiber is composed.

The Theory of the Neural Arc.—The pathway over which the impulse travels in its journey from the sense-organ to the spinal cord or brain and out again to the muscles is known as

[7] Woodworth, R. S., *Psychology,* 1921, p. 24.

the "reflex arc" or "sensori-motor circuit." [8] According to the hypothesis of the neural arc, all stimuli tend to produce changes in muscles or glands; [9] and conversely, all or nearly all changes which take place in muscles and glands are believed to be evoked by nervous impulses traveling over arcs which terminate in them. It must be remembered too that when a muscle contracts, nerve impulses are produced in the kinaesthetic nerve fibers with which it is supplied. Thus (in addition to the nervous connections of the visceral organs) we have two kinds of arcs. One of these begins in a sense-organ in the periphery of the body and terminates in muscle (or gland); while the other begins in muscle and again terminates in muscle (or gland). This distinction is worth pointing out, inasmuch as the arcs which both begin and end in muscle are involved in the explanation of so-called "chain reflexes" and "circular reflexes." Thus in explaining a series of movements each stage in which seems to produce the next, or a case in which the same movement is repeated several times in succession, we may suppose that the kinaesthetic nerve impulses produced by one contraction of muscle become the cue for the next, and so on.

Reflexes of Different Levels.—The term "reflex arc" derives its appropriateness from the circumstance that the impulse may be thought of as passing from the sense-organ to a center in the spinal cord or the brain, and then being reflected to the muscle (or gland) in which the arc terminates. We must not however restrict the idea of the arc to the case of so-called "reflex action." For it is an essential part of the hypothesis that

[8] It must not be supposed, of course, that the "pathway" in any given case is a single nerve fiber or chain of fibers. The "arc" in each case is a larger or smaller system composed of a multitude of fibers. Or, if it is preferred, we may say that the pathway is a *system of arcs*. In many reactions it is probable that the whole nervous system is involved, although some one arc or set of arcs predominates over the others. (Cf. Dunlap, K., *Psychobiology*, 1912, pp. 122 f.) This conception of the functioning of the nervous system does not seem to be essentially different from that of the "Gestalt" psychology. (See Köhler, W., *Psychologies of 1925*, pp. 185 ff.)

[9] A few psychologists would say muscles, glands, or *cerebral neurones*. (See Gates, Arthur I., *Elementary Psychology*, 1925.)

all types of behavior, "voluntary" as well as "reflex," are to be explained in terms of the passage of nervous disturbances over systems of arcs. The systems of arcs which correspond to different types of behavior differ, however, in degree of complexity. Thus in the case of a "reflex" like the knee-jerk or the sudden withdrawal of the hand from a hot object, the impulse probably travels only to the spinal cord and back to the muscles; while when the reaction is "voluntary" the impulse pursues an exceedingly roundabout course, including in its itinerary the spinal cord, a larger or smaller number of centers in the brain, and again the spinal cord, before it is permitted to pass out to the muscles which produce the reaction. (See, however, Chap. VII, pp. 197 ff.)

The Rôle of the Brain.—We have said that mental activity is closely bound up with processes in the nervous system. It is important to recognize that not simply such portions of nervous tissue as happen to be included in the brain but the entire nervous system is functional in mental activity. The traditional notion of "the seat of the soul" has had an unfortunate influence upon our idea of the relation of the mind to the body. It is an exaggeration of the importance of the nervous tissue found in the cranium when we treat *brain* and *mind* as identical terms. And we may go further. There is reason to believe that not only the nervous system but the entire organism should be treated as the vehicle of mentality. In particular, the "glands of internal secretion"—the thyroid and parathyroid, the adrenals, the gonads, etc.—play an important rôle in determining temperament and attitude and what we speak of in a general way as "personality." And indeed a study of the emotional life of man, and of the motives which control our behavior, would seem to require the admission that the *viscera* are almost of equal importance with the brain. It is usually assumed, to be sure, that only nerve impulses which pass through the cerebrum are conscious (or are accompanied by consciousness); but while this assumption is probably correct, it seems to be incapable of complete proof.

7. The Power of Suggestion: Psychotherapy

We have stressed the thought that mental activity is closely bound up with processes in the physical organism. We have seen that mind is dependent upon matter; that there are no psychoses without corresponding neuroses. There are certain phenomena, however, which point to the existence of a power of mind over matter which is fully equal to the power of matter over mind. Among such phenomena are those which are usually included under the general head of "suggestion."

It is not necessary for us to attempt a detailed account of "social suggestion" and "autosuggestion"; or to enter upon a discussion of the *hypnotic trance,* which is a condition of more-than-normal suggestibility, itself produced by suggestion on the part of a person who has acquired prestige in the eyes of the subject. All that is necessary is to remind the reader that there is a wide range of phenomena which the concept of *suggestion* reduces to a certain degree of order.

It is, however, in the field of *psychotherapy* that the power of mind over matter is most manifest. Psychotherapy may be defined as the "treatment of disease by controlling the mental processes of the patient." [10] The use of drugs, massage, electrical stimulation, etc., may in contrast be called *physicotherapy.* If psychotherapy makes use of physical agencies—as carriers, so to speak, of suggestion—it is because these bring about the desired mental effect.

Thus defined, psychotherapy is as old as the medicine man of the primitive savage, and as recent as Christian Science and the Emmanuel Movement. It would be foolish for the man of science to deny that cures have been effected by modern "healers," just as it would be foolish to deny that cures were wrought upon those who experienced the "king's touch," or looked at holy coats and relics. Apparently the cure depends more upon the state of mind of the patient than upon the potency of the physical agency which happens to be employed.

[10] Ewer, B. C., *Applied Psychology,* 1923, p. 259.

The curative power of suggestion must therefore be admitted. Unfortunately, however, disease is caused as well as cured by suggestion; and there is reason to believe that many of the triumphs of psychotherapy are to be explained as an overcoming, by the suggestions emanating from the healer, of the autosuggestions of the patient himself—as well as of suggestions arising from the patient's usual environment—which were responsible for the physical or mental derangement which is thus relieved.

8. The Importance of Early Impressions

The adult human being has a wide repertoire of experiences which tend to produce fear, anger, and similar emotional conditions. Young children, however, respond in these ways to a comparatively small number of stimuli. Thus in the case of fear, an infant responds to only a few classes of stimuli, such as loud noises, a sudden clutch or push, and insecurity of support. Anger in the young child may be produced by interfering with its freedom of movement. The fact that adults respond by way of fear or anger to a much greater number of situations is probably a result of education, or *mis*education, as it might better be called in many cases.

Now it is important to recognize that the experiences which determine the emotional reactions of adults have in a large proportion of cases been forgotten. And it is one of the chief services of "psychoanalysis," as developed by Freud and others, that it has compelled a recognition of the rôle of these forgotten experiences, frequently dating back to early childhood, in producing morbid emotional conditions in the adult. Now that psychoanalysis seems to be in the way of ridding itself of its earlier overemphasis upon the sex-urge, its practitioners may be able to accomplish a great deal of good.

The psychoanalyst attempts, by friendly conversation, by a discussion of the patient's dreams, by the employment of the method of "free association," etc., to enable the patient to recall the tragic excitements and thwarted impulses of one type

or another which, though forgotten—"forgotten" in the sense that they have not been subject to recall—are assumed to be the cause of present emotional disturbance. When the patient has thus been led to understand the causation of his trouble and to perceive that it all results from experiences which from his vantage ground of the present can be looked back upon as relatively trivial, he may be cured of his morbid emotionality.

One cannot help wondering, however, whether it is absolutely necessary that the *real* cause should be discovered; and whether all that is needed is not that something shall be unearthed which the patient (and perhaps also the practitioner) will believe to be the cause of the trouble. In other words, one cannot help wondering whether such successes as are achieved by the psychoanalysts may not be due as much to suggestion as to the effect of the psychoanalytic method itself.

And this leads us to a concluding word of caution. The psychoanalyst must be on his guard lest he suggest to his patient "complexes" worse than those from which the patient is already suffering.

9. The Doctrine of Neurograms: The Subconscious

If, however, we admit that "forgotten" experiences produce present effects, we are confronted by the idea of the "subconscious." A natural point of view is to say that these forgotten experiences persist in an unconscious or subconscious department of the mind. The same explanation may indeed be offered in the case of normal operations of memory. You know that "Columbus discovered America in 1492." Yet you were not thinking of it five minutes ago. But where was the idea when you were not thinking about it? A natural answer is to say that it was stored away in the subconscious mind.

Is an idea or an experience an *entity,* a thing which can be thought of as stored away somewhere; or is an idea an *event,* an act of the organism, which exists only at the moment of its occurrence? Scientific psychology, it should be said, inclines

toward the latter point of view; popular and magazine psychology incline toward the former.

Determining these rival points of view there are two analogies in accordance with which we are likely to think of the processes of learning, retention, and recall. These may be spoken of as the analogy of the filing-cabinet and the analogy of the phonograph. Where is the important business letter which the postman brought you the other day? It is filed away for future reference. Where is the music which you played on the victrola last night? Is it, too, stored away? If by the music you mean the phonograph record, no doubt it is stored away. But if by the music you mean the succession of agreeable sounds, the dulcet tones of Melba or Caruso, it is by no means clear in what sense they can be said to be stored away. For it seems more natural to think of them as existing only when the record is played, and not as existing between times.

In the same way, the psychologist says, there is no reason to think of an idea as existing between times. When "out of mind" it simply does not exist.

But there must be something which exists between times. In the case of the victrola record, what perdures from one time to another is a certain system of traces which as the record revolves, cause motions of the needle. In other words, what remains from one time to the next is not the music itself but rather the mechanism or structure by which the music may be produced when it is wanted. In much the same fashion, certain traces are left in the nervous system which make possible the production of ideas when they are wanted. Just as the tracing on the phonograph record has been called a "phonogram," so Dr. Morton Prince has suggested that the set of changes in the nervous system corresponding to a given idea be called a "neurogram."

There is, then, at least as far as memory is concerned, no need for a mystic, semi-occult conception of the "subconscious" or of "unconscious mind"; the subconscious or unconscious part of the mind may be regarded simply as the sum-total of all the neuro-

grams of a given organism, with the exception of those which are at the moment involved in conscious behavior or thought. (See, however, pp. 213 ff.)

This doctrine of "neurograms," or relatively permanent pathways in the nervous system, enables us to give, in principle, a physiological explanation, not only of memory, but also of both instinctive and learned behavior. All behavior, as we have seen, consists of responses to stimuli. These responses are mediated by the flow of nervous impulses by way of more or less complicated arcs from the sense-organs to the appropriate muscles. But why should any given impulse follow one path rather than another? Obviously because this path is easier than any other. In other words, we assume that the nervous impulse follows the path of least resistance.

The physiological explanation of instinctive behavior is to be found, then, in the additional assumption that already at birth certain *synapses* (that is to say, junction points between neurones) are more permeable than others. Thus already at birth certain stimuli produce definite responses.

To explain learned or acquired behavior, we need still another assumption to the effect that the use of a certain line of discharge makes the impulse more likely to pass that way another time. The oftener a synapse is used the more permeable it becomes.[11] Thus through what we call "practice," a path which at first could only be traversed with great difficulty and which (as a whole) could scarcely be said to be traversed at all may eventually become the path of least resistance.

In general, then, granting the validity of the assumptions which we have made, and assuming the existence of certain "motives" or "interests," an organism's reaction to a particular situation will depend upon the relative permeability of the synapses of its nervous system at the moment in question. While there are no doubt many points which require clearing

[11] Although this idea has been questioned by Lashley and others, it is still, I believe, the prevailing view. An alternative is the theory of *chronaxy* or "tuning." (See Ogden, C. K., *Meaning of Psychology*, 1926.)

up—such, for instance, as the variations of synaptic resistance involved in inhibition and "voluntary" behavior—the whole tendency of contemporary psychology is toward a mechanistic, or physico-chemical explanation of human behavior. Whether a completely satisfactory account of human behavior can ever be constructed on these foundations remains to be seen. The attempt, however, is worth making; and the prospectus has many elements of attractiveness for anyone who is seeking a unified view of man and the world.

The Conditioned Reflex Experiment.—The success of Pavlov and his disciples in describing a precise technique for the establishing of "conditioned reflexes" has contributed greatly to the vogue of this mechanistic or "objective" type of explanation. "Put into a dog's mouth a tasting substance that arouses the flow of saliva, and at the same instant ring a bell; and repeat this combination of stimuli many times. Then ring the bell alone, and the saliva flows in response to the bell." [12] This is what is known in the literature as a "conditioned reflex." (The flow of saliva in response to the taste stimulus is said, technically, to be "unconditioned.") The phrase "substitute stimulus" is, however, more appropriate; for the sound of the bell becomes a substitute for the taste of the food.

What has been known traditionally as the "association of ideas" finds its physiological explanation in this fact of conditioning or substitution. If any two ideas are present in mind at the same time or one immediately after the other, a bond tends to be formed between them so that the subsequent occurrence of either of them has a tendency to bring about the occurrence of the other. Now if we accept the postulate that there is no psychosis without a corresponding neurosis, every idea must have a physiological correlate, which, according to the reflex arc hypothesis, is the arousal of an arc, or a system of arcs. In physiological terminology, the law of the association of ideas then becomes the principle that if any two systems of

[12] Woodworth, R. S., *Psychology*, 1921, p. 303; cf. Gates, A. J., *Elementary Psychology*, 1925, pp. 283-304.

neural arcs are aroused together, the subsequent arousal of one tends to bring about the arousal of the other.

Just why this should be so is, however, not wholly clear. Some psychologists have sought to explain it by the hypothesis of *drainage*. The suggestion is highly speculative, but we present it here for what it is worth. According to this hypothesis, the more strongly aroused of two systems of reflex arcs tends to drain the nervous impulses which would have flowed over the efferent portion of the other. Thus in the case of the "conditioned reflex experiment" referred to above, two systems of arcs are involved. One of these is the set of connections between sense-organs and muscles which would bring about a previously established response to the sound of the bell (as, for example, perking the ears); the other, the set which produces the flow of saliva. The latter set is the stronger and drains the other. In this way, according to the hypothesis of drainage, the substitution of one response for the other (or of one stimulus for the other, depending on which way we prefer to think of it) is accomplished.

Thus in so far as learning may seem to consist in the formation of bonds between "ideas," or between muscular contractions, or between "ideas" and contractions of muscle, all learning would in principle be explained by the doctrine of neurograms together with the postulates which we have mentioned in the course of our exposition. And it is conceivable, fantastic as the idea may at first appear, that, as the power of microscopes is increased and the technique of using them is improved, it may become possible to discover the precise respects in which the synapses are altered by the acquisition of skill or by learning of any kind. It may even become possible to tell by a post-mortem examination whether the deceased knew the multiplication table or not! Whether some method will then be discovered of directly molding the nervous system according to the desired pattern, instead of depending as at present upon mere repetition and practice, must be left to the imagination of the reader!

The Mechanistic Point of View in Psychology.—The tendency of our discussion is in the direction of a mechanistic view of life and of mind. Whether or not this point of view can be regarded as finally satisfactory must be left to the next chapter. It may not be amiss to point out here, however, that *applied psychology* presupposes some measure at least of the mechanistic attitude. It must postulate "determinism" (see pp. 303 f.); for it is only as we think in terms of cause-effect relationships that any application of the principles of psychology to the control of behavior is possible.

If this point of view be adopted, we may hope to discover laws of learning and forgetting, principles governing the optimum arrangement of periods of work and rest, and devices for testing and measuring psychological abilities and achievements, which will be comparable in point of certainty and reliability to the corresponding generalizations and procedures of physics and chemistry.

Thus, as a result of the achievements of biology and psychology, we may look forward to the establishment of a science of *human engineering*. Having conquered nature, man may yet learn to control himself.

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CHAPTER VII

BIOLOGY AND PSYCHOLOGY—PERPLEXITIES

1. Is Life Eternal or Did It Emerge from the Non-Living?

We have probably included in our survey enough of the achievements of biology and psychology to convince the reader that the mechanistic type of explanation has made great strides in the realm of life and mind, as well as in that of the non-living. There are, however, many problems which still await solution. One of these is the question of the beginning of life upon our planet.

Assuming the existence of living matter to start with, it is conceivable, I suppose, that all existing species may have arisen by a process of variation and natural selection. But how shall we account for this primordial life? Two alternatives may be suggested: (a) that life is eternal; or (b) that it has developed out of non-living matter.

(a) The Idea that Life is Eternal.—If it is permissible to assume that the *matter* of the universe is eternal,[1] it is at least conceivable that *life* is also eternal; in other words, that in addition to non-living matter there has always been living matter.

To be sure, if we should accept the Laplacian nebular hypothesis of the origin of the solar system, there must have been a time when our planet was absolutely devoid of living matter. If we accept the planetesimal hypothesis, however, this is by no

[1] Matter, indeed, may not be eternal (see p. 94); but "for the sake of the argument" we may suppose that it is. If this supposition be granted for matter, there can be no valid *a priori* objection to the same supposition in the case of life.

means so certain; for some of the planetesimals which came together to form the earth may have contained life in relatively simple forms.

Suppose, however, that we assume for the sake of the argument that our earth in its earlier geological stages was absolutely lifeless. On this assumption it may be conjectured, in accordance with the suggestion of Arrhenius, that life was brought to the earth from some other planet of our system, or from some other part of the universe. According to this speculation, life in the form of *spores* might be carried from one part of the universe to another by the radiant energy of light. If we remember that light is now known to exert an appreciable pressure, and that spores are able to survive exposure to very low temperatures, the speculation is not so fantastic as it may at first seem.[2] Considered as a theory of the origin of life, the idea is, of course, unsatisfactory; for it would postpone rather than solve the problem. But at present we are not seeking for an absolute origin of life, but only for an explanation of its origin upon our planet. And it is certainly not absurd to suppose that from eternity to eternity there may have been living organisms somewhere, or for that matter, in a great many wheres; and that, just as a bit of ground, where the vegetation has been destroyed by a bonfire does not remain permanently bare, but will after a time be covered by a new growth of grass and weeds, so any part of the universe which has been denuded of life by some cosmic cataclysm will, when conditions have again become more favorable, be reseeded, so to speak, with living forms from other parts of the universe to which the cataclysm did not extend.

(b) The Idea that Life Has Developed Out of Non-Living Matter.—The theory that life is eternal, that living organisms have always existed in some part of the universe and have been transported to the earth, must, however, share the

[2] It may be objected, however, that Millikan's "cosmic radiation," or even ultra-violet light, would be fatal to living matter in transit from elsewhere to this earth.

field with the radically evolutionary hypothesis that life on our planet, and perhaps elsewhere, has arisen out of the non-living.

The *a priori* objection that "a stream cannot rise higher than its source," or that "the cause must contain at least as much reality as the effect," may be disregarded; for *a priori* arguments concerning what *may* be have no value as against empirical evidence of what has been or now is.

The real difficulty with the radically evolutionary theory of the origin of life is empirical; for there is no authentic case of the appearance of life where there was no previous life. The old belief in "spontaneous generation" of life as we ordinarily think of it has been destroyed by our experience with sterilization. It was formerly supposed that maggots and other forms of life appeared spontaneously in filth; but it has been proved that a solution which has been completely sterilized by heat and then hermetically sealed to prevent the entrance of organisms from the air or other media will remain free from micro-organisms of any kind.

Mechanistic biologists, however, are men of faith—in mechanistic biology. They believe that life may eventually be proved to arise from the non-living. And it must be admitted, as a matter of pure speculation, that even if the spontaneous generation of micro-organisms does not take place under conditions now obtaining, it may have taken place ages ago, when conditions were very different from those existing now. Or it is conceivable that micro-organisms have never appeared spontaneously but that simpler forms of life may nevertheless originate in this manner.[3] It is possible, indeed, that in the realm of the very small there is no sharp line of distinction between the living and the lifeless; but that, just as there are forms of life which seem to be intermediate between the vegetable and the animal, so also there may be a continuous gradation of forms between the living and the non-living.

At any rate, I would not advise anyone to base his philosophy

[3] For example, it is possible that non-filterable viruses may have arisen spontaneously.

upon the dogma that it is impossible for life to come from lifeless matter; or that the chemist will never succeed in producing it in his laboratory. Indeed, the chemist's success in the artificial synthesis of so-called "organic" compounds encourages the expectation that he will yet succeed in making living protoplasm out of "inorganic" material. You'd better not wager your religion and your ethics, then, upon the chance that he'll never be able to do it; for he may some time do just that! (See pp. 106 f.)

2. What Is the Cause of the Variations or "Mutations" which Are Assumed to Take Place in the Germ Plasm?

As we saw in the preceding chapter, there is little or no ground for question as to the *fact* of the transformation of species through natural descent. There is, however, considerable uncertainty as to the *method* by which this transformation is effected.

It is as if we knew for a certainty that a man has traveled from New York to San Francisco; but did not know how he made the journey, whether by airplane, railroad train, or automobile. It is obvious that the question *whether* the journey has been made, and the question *how* it has been made, are two entirely distinct questions. Unfortunately, however, in the controversy which has arisen over the idea of evolution, some of the disputants do not succeed in keeping these questions separate.

In what follows we shall be thinking not at all of the question of *fact,* concerning which there is substantial agreement among all competent biologists; but solely of the question of *method,* concerning which there is a considerable measure of disagreement.

According to the theory of Lamarck, the characteristics of a species might be changed by long-continued use or exercise. Darwin, on the other hand, without rejecting the Lamarckian explanation, added another, upon which he laid chief stress.

This was the famous principle of natural selection in the struggle for existence. The young are never exactly like their parents; they always vary in one direction or another. By taking advantage of this fact of variation, breeders have produced the various strains and breeds of animals and fowls with which we are familiar. This is *artificial selection*. Now Darwin held that there has also been a *natural* selection which has worked through the ages, somewhat more slowly perhaps, but no less surely, to produce new forms of life. Thus according to Darwin the various species of plants and animals now existing were produced in essentially the same manner in which breeds and varieties of domesticated animals and plants have been produced, that is to say, through variation and the elimination of such variants as are not adapted to the conditions of life.

According to Lamarck, to use the hackneyed illustration, the long neck of the giraffe is due to the circumstance that for generation after generation these animals stretched their necks in the effort to feed off the boughs of trees; according to Darwin, the elongation of the neck was produced by the fact that for generation after generation the shorter-necked giraffes were eliminated in the struggle for existence.

Herbert Spencer employed both the principle of use and exercise and the principle of natural selection in explaining the rise of new species. He coined the phrase, "survival of the fittest." Weismann, on the other hand, out-Darwined Darwin in his advocacy of the principle of selection. The Lamarckian explanation requires us to assume the transmission of "acquired characteristics." Weismann maintained, partly on *a priori* grounds, partly on observational grounds, that such characteristics are not transmitted. And most contemporary biologists agree with Weismann on this issue.

All of these older thinkers assumed that the modifications which occur in natural descent are very small, and that the transformation of species is therefore gradual and almost imperceptible. More recent work has shown, however, that "mutations" sometimes occur. These are more abrupt changes which

have their seat in the germ plasm and are accordingly transmitted to the offspring of the individual plant or animal in which they occur.

But *what is the cause* of these variations or mutations in the germ plasm? Most biologists are agreed, as we have seen, that they are not to be accounted for in the Lamarckian manner, as results of the experience of the individual organism. Science, however, postulates determinism; everything which takes place must have a cause. If the variations are not the results of use and disuse, if they are not produced by the environment, whence do they come?

Darwin was content to call them "accidental." He also spoke of them as "random" or "chance" variations. By this he did not mean that they were uncaused; but merely that their causation was beyond our present powers of investigation. The problem is essentially the same for the mutationists as it was for Darwin. It may be, indeed, that the X-ray experiments of Müller and others [4] will point the way toward an explanation of the causation of mutations; for these workers have found that when certain organisms—for example, fruit-flies—are subjected to the X-ray treatment, mutations occur much more frequently in their progeny than in the offspring of organisms not treated in this manner; and we may conjecture that the effect of the X-ray bombardment is to dislodge electrons from the complex molecules which compose the "genes," thus changing their chemical composition and indirectly producing an alteration of the characteristics of the organism to which they give rise. Nevertheless, while it may be supposed further that the "cosmic rays" and other radiations occurring naturally may have the same effect as the artificially produced X-rays—only operating more slowly—we must admit that the hypothesis is as yet highly speculative. Moreover, in the light of our present knowledge variations produced in this manner would still be "chance" or "random" variations; for there is no reason to suppose that they would be directed toward better adaptation any more

[4] See *Science*, Vol. 66, July 22, 1927.

frequently than toward worse adaptation. Indeed, many of the variations which are produced in this manner are found to be "lethal"; that is, individuals in which they appear cannot "grow up."

It will be observed that in the foregoing hypothesis, while the effects of use and exercise are not thought to be transmitted in the manner supposed by Lamarck, the variations or mutations which occur in the germ plasm are nevertheless regarded as due to environmental influences. A somewhat older suggestion—for which, however, there appears to be little or no evidence—is that "hard times" may produce a tendency to mutate; that a species which is well adapted to its environment remains relatively free from variation, while one which is ill-adapted tends to vary. If this suggestion could be accepted, the behavior of a mutating species would be analogous to the "trial and error" activity of an animal which is suddenly thrown into a novel situation. But even if it could be proved that adversity causes a tendency to mutate, it would still be necessary to inquire whether the mutations are directed toward better adaptation or whether they take place in strictly random fashion.

Another hypothesis, advanced by Bergson and others, is that the variations or mutations which appear in changing species are directed by an *élan vital* or "entelechy." According to this view, evolution is a manifestation of purposive striving. The "purpose" is not to be thought of, however, after the manner of human intelligence but rather of animal instinct; and in view of the great number of extinct species revealed in the story of the rocks, it would be rash to assume that this directed or "orthogenetic" evolution always tends to produce better adaptation. Accordingly, even if we should accept the doctrine of "orthogenesis," or directed evolution, it would still be necessary to invoke the idea of a natural selection of orthogenetic trends.

It is clear, then, that in this matter we are still in the realm of almost unfettered speculation. The best, perhaps, that can

be said in the present state of science is that the biologist simply postulates, *i.e.* accepts the fact of, variation; and furthermore that he also postulates that some of the variations (call them mutations, if you will) have their seat in the germ plasm and are therefore transmissible. Whether these postulates will some day become theorems is, of course, another question.

3. How Is It Possible for a Structure So Complex as the Adult Organism to Be Predetermined in a Structure So Simple as the Fertilized Ovum?

In so far as the traits of men and animals are hereditary, they must somehow be predetermined in the single cell from which the organism develops. Yet the complexities of structure which our microscopes discover in the fertilized ovum are not sufficiently great or sufficiently numerous to account for the complexities of structure found in the adult. For example, the fertilized ovum which is going to produce a bird of a certain species, with its peculiar song, manner of nest-building, etc., must differ from the ovum which is to produce a bird of a different species.

There is, of course, the probability that advances in microscopy will reveal hitherto unsuspected complexities of structure in the ovum; but unsuspected complexities may also be discovered in the adult organism as well. And, if we bear in mind that native *mental* traits must be grounded in the nervous system, it seems very unlikely that it will ever be possible to establish a one-to-one correspondence between the structure of the adult organism and that of the cell from which it is sprung.

At this juncture the "vitalist" intervenes. He tells us that the attempt to explain the growth and development of the organism by reference to the structure of the ovum is doomed to failure. The growth of the organism, he insists, is only partially explicable in terms of a space-time mechanism; and he accordingly maintains the necessity of postulating the existence of a non-physical directive agency—a "life-force," "entelechy,"

or "psychoid"—to account for those traits of the developing organism which cannot be explained in terms of original structure.

To this, however, the mechanistic biologist is likely to reply that the vitalist is simply a "quitter." The same objection might indeed have been urged against the Bergsonian conception of the *élan vital* as the directive agency in the transformation of species. For whether it is a case of the evolution of the species or of the development of the individual organism, in having recourse to the idea of a life-force, elan, entelechy, or psychoid as the cause of phenomena, the vitalist is in reality surrendering all hope of ever attaining a genuine explanation. For the entelechy, or whatever we name the mysterious directive agency, is by hypothesis an imperceptible entity—an entity, indeed, which can never be reached by any method of research whatsoever.

We must, it seems to me, feel a measure of sympathy with the protest of the mechanist. The vitalist is guilty of postulating an agency about which we can never hope to learn anything. Under the guise of explaining a mystery, he is simply giving a name to our ignorance. And yet the case is not quite so clear as one might wish. For the mechanist also postulates something unknown. He postulates more structure in the ovum than the microscope reveals or ever will reveal.[5] Both the mechanist and the vitalist, then, postulate the unknown. Nevertheless the mechanist, in my judgment, has a little the better of the argument. His advantage lies, it seems to me, in the fact that, while the vitalist postulates an unknown which is utterly unlike anything which is objectively discoverable, the unknown postulated by the mechanist is of the same general kind as that which he already knows, and concerning which his knowledge is daily increasing.

[5] The same may be said, of course, of the procedure of the physicist and the chemist in their treatment of molecules and atoms.

4. Is Difference in Degree of Complexity the Only Difference between Conscious Behavior and Behavior which Is Not Conscious?

It may be well to remind ourselves again that in this chapter we are dealing not with achievements of science but with perplexities. Concerning these matters there is no room for dogmatism. And if, by a desire for brevity of statement or by the enthusiasm of the moment, we are now and then betrayed into pronouncements which have a ring of finality, it is to be hoped that the reader will regard these as only occasional lapses from grace, for which we are duly penitent.

Our conviction of ignorance becomes, if possible, even more profound as we now pass on to a discussion of the perplexities of "mind" and "self." The attempt to explain all mental phenomena mechanistically has reached its most thoroughgoing expression—whether we can accept this explanation is, of course, a question for discussion—in the contemporary movement known as "behaviorism." The central principle of behaviorism, it seems to me, is the thesis that so-called "conscious" behavior is merely more complex behavior.

We must agree, I think, that there are at least two respects in which conscious behavior is more complex than that which is not conscious. In the first place, the system of neural arcs is more complicated; the paths traversed by the nervous impulses are longer and more roundabout, probably involving more resistance, and a greater number of arcs are aroused simultaneously. Thus there appears to be no consciousness unless the itinerary of the nervous impulses includes the cortex of the cerebrum. This need not be interpreted to mean that the cortical neurons are in any peculiar sense the seat of consciousness, but merely that consciousness is dependent upon the integral functioning of arcs which include the cortical neurons.

In the second place, conscious behavior is more complex in that it involves a greater number of muscles and glands. Thus the flow of the gastric juice, the peristalsis of the intestine, the

beating of the heart, the movements involved in breathing, the frequent winking which moistens and washes the eyeballs, or any operations which for the most part proceed automatically and without clear consciousness, are all relatively local; while in behavior which is fully conscious the organism is usually active as a whole.

But though it be granted that conscious behavior is as a rule more complex than behavior which is not conscious, it does not necessarily follow that this difference is the only difference. It may be that a certain complexity of muscular and glandular activity, or the arousal of certain parts of the nervous system (as, for example, the association tracts of the cerebrum), or both of these may constitute the occasion for the emergence of entities of an entirely different order from the physical processes which condition them; and that these "psychic" entities can be known in no other way than by "introspection."

On the other hand, there does not seem to be any insuperable obstacle to the adoption of the hypothesis that physical activity of a certain degree of complexity, or physical processes involving certain parts of the organism (as, for example, the association regions of the cerebrum) simply *is,* or *are,* what we speak of as "consciousness." Thus, according to this conception, physical process and psychic experience would ultimately be one and the same thing; but this selfsame reality would be describable (in principle) by two sets of terms.[6]

A difficulty which some of us may have with this position, that consciousness is simply to be identified with complexity of

[6] Even this, of course, would be objectionable to the negative or Watsonian behaviorists, who seem to pride themselves on their refusal to recognize certain facts, of the reality of which everybody else is persuaded. A refusal to recognize facts does not, however, destroy their existence. That some of our actions are conscious and others unconscious; that to-day I can remember that yesterday I was conscious of behaving in a certain way, in other words, that I *am* conscious that I *was* conscious—these are as genuine facts as any of the phenomena dealt with by any of the sciences. Indeed, although I may be the only person who can observe it, my knowing that I am behaving is itself just as truly a case of behaving as any other; and as such must be taken into account by any psychology which wishes to be considered a genuine behaviorism.

physical process, flows from the consideration that this identification seems to make consciousness *nothing but motion;* for it is hard to think of a set of motions as *knowing* anything. How, indeed, could one system of physical changes be aware of other systems of physical changes? This question, however, may be merely an appeal to prejudice; and—whatever the factual difficulties that are inherent in the conception—there may be no really serious logical difficulty in the suggestion that a set of motions may become the subject as well as the object of the cognitive relation. It must be recognized, too, that the phrase "nothing but motion" is a question-begging expression; for if there be a set of motions which is consciousness, it must then be admitted that "motion" is a far richer concept than we at first supposed.

Summary: The Theory of Occasionalism.—All four of the "perplexities" thus far discussed in this chapter—the problem of the source of life on our planet, of the transformation of species, of the development of the individual organism, and of the relation of consciousness to physical process—lead us to *a theory of levels* or, as I prefer to call it in view of the fact that there seem to be not only six or eight but rather a multitude of such discontinuities, a theory of *naturalistic occasionalism* (cf. Chap. V, p. 157). For no solution of these problems (unless, perhaps, of the first) is possible which does not repudiate the pseudo-axiom that "there can be no more in the effect than was in the cause." If we accept the view that life arose out of non-living matter, we can only hold that our universe is such a universe that upon the occasion of a certain configuration of protons and electrons properties appear which we designate by the adjective "vital." If we believe that new species arise out of older and different forms of life, we must admit an obvious discontinuity in the emergence of "mutants." If we agree that every individual organism develops out of a single, relatively simple cell, we must recognize the existence of a more complicated structure in the effect than we can ever hope to discover in the cause. And, finally, if we are to find a

solution of the problem of the relation of consciousness to the physical organism, we must accept the principle that the whole is more than the sum of its parts. For, whether we say that the inner experience which we call consciousness or awareness is identical with a complex set of physical processes, or that it is a fact of a higher order which supervenes on the occasion of a certain complex set of physical processes,[7] in either case we regard the whole as possessing properties not possessed by its parts considered separately.

5. Do Mind and Body Interact?

An implication of the position which we have just outlined would be that "mind" and "body" are not distinct entities, that the relation of a physical event to a mental event is not a case of *"either . . . or,"* but rather a case of *"less . . . more."* Now some at least of our remaining "perplexities" might be shown to be already solved in principle, if this suggestion be accepted. Not everyone, however, may be ready as yet to accept it; and it will, I think, be better and fairer to begin in each case with what may be called the "common-sense" point of view. (Scientists, you remember, and philosophers are not content to remain men of common sense.)

Now any theory which treats mental and physical entities as distinct, as common sense is inclined to do, must face the question of interaction. Not considering here spiritualism and the identity or double-aspect theories, three points of view may be distinguished. These are *interactionism, parallelism, and epiphenomenalism.* They may be represented by the diagrams shown on the opposite page.

In these diagrams, the o's represent mental events; the x's represent physical events. We say "events" rather than "states" so as to leave open the question between the substantialist and the actualist. (See p. 211.) The lines indicate causal relations. In the case of interactionism, there is causal influence, both within each series and between members of the two series. In

[7] For a discussion of these alternatives, see pp. 197 ff.

other words, each mental event (or state of mind) may be the cause of a subsequent mental event or of a physical event, or of both. And in turn any physical event or change taking place in the body may be the cause of another physical event, or of a mental event, or of both. In the case of parallelism, on the other hand, while there is a causal influence within each series—a mental event producing a subsequent mental event, or a physical event producing a subsequent physical event—there is no action of the mental upon the physical or of the physical upon the mental. Each series, on this view, is self-contained. There is correspondence but no interaction between the two series of

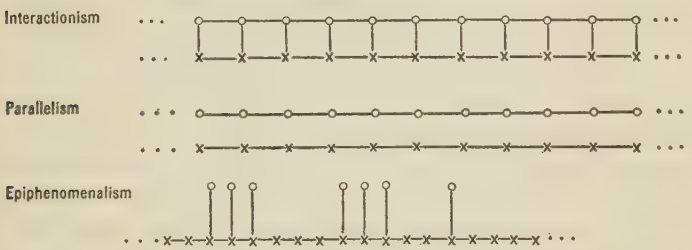

FIG. 2. Three Views of the Relation between Mind and Body.

events. In epiphenomenalism, the fundamental reality is supposed to be physical. There is an action of matter upon mind, of the physical event upon the psychical, but not a reciprocal influence of mind upon matter. Furthermore, the mental series is discontinuous. Some physical events are accompanied by mental events and some are not. Also within the mental series there is no causal influence, each mental event being produced solely by its accompanying physical event and owing nothing to any preceding mental event. In other words, according to the epiphenomenalist theory, mental events have no efficacy whatsoever; they are inert accompaniments of the physical changes which alone have causal significance. This view has been illustrated by saying that so-called "conscious states" are like the shadows which accompany the motions of a cart on a bright sunshiny day. The revolving wheels produce moving shadows

on the fence or the roadside; but the motion of the shadows has nothing to do with making the wheels go round. Or a mental event may be compared to the color which appears in the course of a chemical reaction. The reaction produces the color, indeed this particular type of reaction never takes place without the emergence of this particular color; but no one would say that the color has anything to do with producing the reaction.

Difficulties of Interactionism.—The question of interaction is one of the moot points of philosophy and speculative psychology, and it will be worth our while to tarry with it for a time. There are two main objections to interactionism.[8] In the first place, it is objected that interaction between mind and matter is inconceivable. These two, it is said, are so unlike that it is unthinkable that one should act upon the other. The objection, however, depends upon an assumption. It depends upon the assumption that the cause and the effect must be similar, that only like can influence like. The assumption, however, need not be granted. As someone said long ago, it is no more obvious that only like can influence like than it is "that only fat men can drive fat cattle." This is not a question which can be settled by *a priori* reasoning. If experience testifies that mind is able to influence matter it is idle to protest that action of mind upon matter is inconceivable.

Another way of meeting this objection is to point out that all interaction is mysterious; therefore why make so much of the mystery of interaction between mind and matter? It may at first seem easy to explain the action of one bit of matter upon another. More careful consideration shows, however, that the affair is not so simple. For a bit of matter, as we have learned, is not really a solid continuum, as it appears to be. A piece of matter, such for example, as a ball or a bat, is "mostly empty space." Or it is a swarm of electrons and protons. Just how one bit of matter is able to push another piece of matter is, then, a

[8] It should be noted that we are here discussing the problem from a point of view which many contemporary psychologists would regard as obsolete, and which we ourselves have sought to transcend. (See p. 200.)

good deal of a mystery. We might expect the two swarms of electrons and protons to interpenetrate, just as two flocks of sheep might do. You say that the electrons repel each other. True! But why or how they repel remains a mystery, just as the attraction of the proton for the electron is a mystery, or, to turn now to the behavior of gross matter, just as "gravity" or magnetism is a mystery. All that we can do at this stage of the investigation is to postulate these repulsions and attractions. In just the same way, and by precisely the same right, we may postulate the action of mind upon matter and *vice versa.*

Another and perhaps a more important difficulty of interactionism is that it appears to involve a violation of one of the most firmly established generalizations of physical science, the law of the conservation of energy. According to the law of conservation, as we have seen, the amount of energy in any physical system is constant unless work is done upon it or done by it or there is a transfer of energy between it and another physical system. Now it is objected, if mind acts upon matter, as for example when I will to raise my arm and the arm rises, energy is injected into the physical system. On the other hand, if matter acts upon mind, as when a light stimulus affects my retina and the impulse is carried to the brain where it produces a sense-datum of brightness, work is done by the physical system and energy has been consumed. Thus it is held, if interaction be admitted, the energy of the system does not remain constant, and interaction is therefore at variance with the law of conservation.

Is the Law of Conservation Universally Valid?—Some thinkers have tried to meet this difficulty by questioning the universal validity of the law of conservation. It is suggested that the law of conservation is valuable as a principle of method to be employed in the laboratory, but that it is not to be regarded as a valid principle of explanation. Or it is maintained that, even if it may be established for the physical realm, there is no good reason to suppose that it holds in the realm of mind.

This does not seem to me to be a very promising way of escape. It is no doubt true that it is impossible to give an absolutely cogent demonstration that the law of conservation is true in the realm of mind, or even in the realm of living organisms. There are, however, no facts that cannot be reconciled with it, and experimental work so far as it goes appears to support it. In order to defend interaction it does not seem to me to be necessary to attack the universality of the law of conservation; it is enough to interpret it properly.

Reasons for Preferring Interactionism.—As has been suggested, the law of conservation when properly interpreted is not incompatible with the interaction of mental and physical events. The law states that within any *isolated* physical system, no matter what takes place within the system, the quantity of energy is constant when allowance is made for the transformation of one form of energy into other forms. Now if mind is regarded as outside the physical system—the individual organism, the room or house in which it lives, the planet, the physical universe—there is no more difficulty in supposing that the amount of energy in the physical system is increased or diminished through interaction with mind, as is maintained by those who urge this as an argument against interactionism, than there is in supposing that it is increased or diminished through interaction with some other physical system. The circumstance that within certain circumscribed systems—as, for example, a "calorimeter"—no increase or diminution of energy which cannot be physically accounted for has ever been discovered might then be due to the fact that the quantities concerned are too small to be detected, or to the fact that there is a balance or approximate balance of gains and losses.

The misunderstanding has arisen, it would seem, through extending the "system" in which there is assumed to be no gain or loss of energy so as to include the universe, and then excluding mind from the system. Either mind should be included within the system or it should be excluded; and on neither of these assumptions is interaction really incompatible

with the law of conservation. For if the latter alternative is chosen, mind then becomes another system, which as we saw in the previous paragraph interacts with the physical system in the same manner in which two partial physical systems may interact with each other.

On the other hand, if mind is assumed to be included within the system, all that is required to reconcile interaction with the law of the conservation of energy is that we think of mental energy as another form of energy, analogous to the various forms which we already distinguish. Indeed, if energy is the power to do work, and if by the hypothesis mind is able to do work upon matter, there must be mental energy. It is not necessary to suppose that large amounts of energy are involved in these transformations of mental into physical energy, and *vice versa.* Indeed, the reflex arc hypothesis would suggest that the quantity of energy is very small. The function of mind, on the interactionist hypothesis, is not to furnish the energy to do the work of the body, but rather to direct the flow of the energy already present in the body. Mind merely supplies the energy required to control the flow of energy. Mind opens or closes the throttle, presses the button, or throws the switch. There need be no creation of energy when mind acts upon body; the energy employed by mind in controlling body is drawn from body when body acts upon mind.

Just how this control is effected is at present unknown. We have seen that, according to contemporary theories, instinctive and habitual behavior are supposed to be produced by pathways in the nervous system. The acquisition of skill, the formation of habit, "learning" of any kind, is due to changes in the synapses. (See p. 183.) It may be conjectured, then, that conscious control of behavior is due to *temporary* changes in the synapses. We may suppose that "purpose," "volition," "intention"—by whatever name we denote the efficient functioning of mind—produces these temporary synaptic changes. The synaptic changes would then be the physical events which are in direct causal relation with mental events.

Parallelism implies that *every* physical event is accompanied by a mental event, a view for which there is no empirical support. Again parallelism supposes a correlation of mental and physical states without any causal connection—a view which suggests some sort of mysterious "pre-established harmony," or else a blank, unrelieved mystery. Furthermore, both parallelism and epiphenomenalism leave the presence of purposive consciousness in our world without any explanation. It is here, but it does nothing. Now it is not impossible that evolution should have produced a do-nothing sort of thing; but it is improbable. Mind *seems* to act upon body. It is only by subtle theorizing, if at all, that this seeming interaction can be explained away. And there is really no serious objection to the hypothesis. We conclude, therefore, that of the three theories which we are considering in this section interactionism is the most probable.[9]

6. Is the Series of Psychic Events Associated with a Given Human Organism Causally Continuous?

One of the differences between parallelism and epiphenomenalism, as represented above, is that in the former each of the two series, the mental as well as the physical, exhibits a continuous cause-effect sequence; while in the latter only the physical series is continuous.

Now in this respect epiphenomenalism is certainly closer to experienced fact than parallelism. For our mental life is empirically *dis*continuous. We sometimes go to sleep. Under the influence of anæsthetics or in fainting spells we become unconscious. Thus when we look back over our past conscious experience we find it to have been broken into longer or shorter periods, separated by intervals of unconsciousness. It is possible, of course, that there are no real gaps in the "stream of thought," but that the apparent gaps are the result of forgetfulness. This, however, is theory rather than observed fact. It

[9] To say that mind acts upon body is not the same, however, as to assert that *consciousness* causes bodily movements. (See p. 208 n.)

is only through "introspection" that such intermediate psychic events could be observed; and a fair reading of experience gives us the existence of psychic events for only parts of the time.

It may, perhaps, be objected that I can never have an immediate awareness of periods of unconsciousness, either in myself or in anyone else; and that my alleged knowledge of such "gaps in consciousness" is merely a matter of hearsay and inference. And there is, I think, a sense in which the truth of the objection must be granted. Nevertheless, it seems clear that we have a genuine knowledge of them; and that it may fairly be said to be empirical. It is, to be sure, the result of a coöperative experience; but it can be shown that this is true of many of our so-called "data of experience."

Accordingly, if interactionism is, in other respects, a better account of the facts of experience than either parallelism or epiphenomenalism, we should now inquire whether the general interactionist position cannot be modified or interpreted in such a way as to include the recognition of the discontinuity of the psychical series. In other words, the theory which we are seeking will be a compromise between interactionism, as ordinarily understood, and epiphenomenalism.

Let us then distinguish three forms of the general interactionist theory, which, for want of specific names, we may speak of as "Interactionism (a)," "Interactionism (b)," and "Interactionism (c)." [10] The first of these may be thought of as the radical or thoroughgoing form of interactionism; the second as a compromise between interactionism and parallelism; and the third, which alone makes room for the empirical discontinuity of the psychical series, as a compromise between interactionism and epiphenomenalism.

Employing the same conventions as before concerning the meaning assigned to the o's, the x's, and the connecting lines,

[10] It must of course be understood that all three of these sub-theories presuppose a sharp distinction between *mental events* and *physical events*—a distinction which, in principle, we have already rejected.

the three forms of interactionism may be represented graphically, as follows:

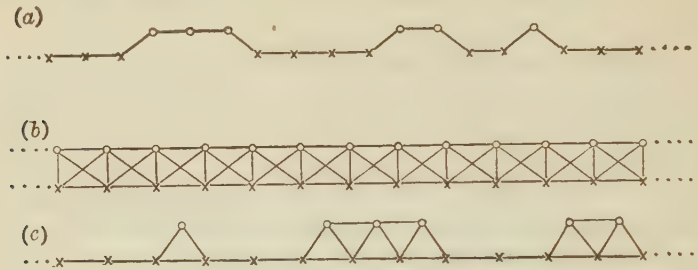

FIG. 3. Three Forms of the Theory of Interaction.

Of course, all such diagrams are inadequate to represent fully the complexity of the situation; and there might be various combinations of (a), (b), and (c). But, I hope, the main distinctions will be clear. In the first kind of interactionism, both series are assumed to be discontinuous; in the second, both are continuous; while in the third, the physical series is assumed to be continuous and the mental series discontinuous.

In other words, in "Interactionism (a)" there are mental events which are produced exclusively by physical events; and there are physical events which are produced exclusively by mental events. In "Interactionism (b)" every event, whether mental or physical, is assumed to result from the coöperation of both mental events and physical events. While according to "Interactionism (c)" there are no physical events which are produced exclusively by mental events; but now and then there is a mental event whose causation is exclusively physical.

"Interactionism (c)" is then in accordance with our experience of gaps or interruptions in the stream of consciousness. It must, however, be distinguished from epiphenomenalism; for it recognizes the action not only of body upon mind but also of mind upon body. Mind, it is true, is more transitory than body; yet while it lasts, mind is efficient.[11]

[11] The difference between this point of view and that of epiphenomenalism may seem to be somewhat tenuous. Indeed, a careful definition of terms

The reader may compare this view of mind with the doctrine of the rôle of purpose suggested in our discussion of the issue between mechanism and cosmic teleology. (See Chap. III, pp. 55 ff.) It is believed also that this doctrine of the mind-body relation will be helpful when we come to discuss the problem of the origin of that stream of psychic events which I think of as "myself." (See p. 219.)

Interactionism and the Idea of a Mental Event as a Whole.—While "Interactionism (c)" has been arrived at by setting out from the "common-sense" view of mind and body (and therefore of mental events and physical events) as distinct entities, it will be found in nearly all respects to be in essential agreement with the doctrine that a mental event is a *whole* of which physical events and processes are *parts*. (See p. 200.)

For it will be remembered that according to this doctrine the whole is assumed to be more than the sum of its parts. If, then, instead of saying that the mental event *is* the whole, we should define it as the "more" which distinguishes the whole from the parts, we might in that way arrive at a doctrine exactly equivalent to "Interactionism (c)." For thus defined, a mental event would be an entity which emerges out of a combination of physical processes, but is nevertheless to be distinguished from them; and it might be supposed to react in such a way as to coöperate in the production of other physical processes and mental events.

It seems necessary, however, to take another step away from the position of "common sense," and to give up entirely the notion of a radical distinction between mind and body, except for the reservation that in every given case the mental entity

might cause it to disappear entirely. Thus if we define consciousness as "awareness," we may agree with the epiphenomenalist that consciousness as such is not efficient. On the other hand, it seems clear that conscious processes (that is to say, physiological processes which have the quality of being conscious) *are* efficient. In the same way, it is unlikely that anyone would maintain that the characteristic color which appears on the occasion of certain chemical reactions enters *as a cause* into the series of reactions. Nevertheless, we should have to admit that the colored solution (that is to say, the solution which manifests the color in question) is a cause of subsequent reactions.

is more than the physical entity or entities which it includes as its parts. The difficulty that arises when we define a mental event in the manner suggested in the preceding paragraph, as that by virtue of which the whole is more than the sum of its parts, is that this "more" is never found introspectively but is a mere abstraction. It is separable in thought; but it is hard to believe that it is separate in reality. For all mental events which we know anything about seem to be *both physical and mental*. In other words, the entities with which we deal in psychology are never psychical merely, but always psycho-physical. It is important to recognize, however, that even if we define a mental event as itself a whole, the parts of which are physical processes, we are still obliged to admit an interaction between mental and physical processes. For the conscious activities of the organism, which are then to be regarded as mental activities, would be interacting with the processes of the physical environment, as well as with unconscious processes taking place within the organism itself.

7. Should Psychic Elements Be Regarded as States of an Immaterial, Unitary Self?

If we accept the conclusions arrived at in the last three sections, we should be obliged of course to answer the present question in the negative. It may be better, however, to begin again from the traditional, "common-sense" point of view, and to justify our answer step by step.

By "psychic elements" we mean such things as percepts, thoughts, feelings, purposes, etc. The terms which we are compelled to employ have been used in so many diverse senses that it is hard to avoid ambiguity. But the meaning of the question is sufficiently clear to permit discussion. As we have put it, the question may be subdivided into two parts, one relating to the unity of the self, the other to the relation between the self and the physical organism.

The question of unity may be phrased thus: Are the elements of consciousness *states* of the self, or are they *constituents* of

the self? The former doctrine is known technically as "substantialism," and the latter as "actualism." The former is the traditional view; and is still, I suppose, the position of "common sense." It has accordingly determined the customary forms of language. Thus when we speak of "conscious states" or "states of consciousness," the very language which we employ obviously implies that behind or underneath these "states" there is a permanent reality or substratum of which they are but modifications. Thus substantialism would speak of the self *and* its states. It would say that there is a core of fundamental selfhood or personality which possesses these psychic states, or in which they "inhere."

According to actualism, on the other hand, there is no core; there is no underlying substance, of which psychic elements are "states" or modifications. In other words, the self does not *have* states; the self simply *is* the sum-total of the so-called "states of consciousness." The actualist refuses to recognize anything except the *actual facts* of experience; and among these, he holds, are sense-impressions, ideas, etc.—but no substantial self. This point of view may be illustrated by an experiment with an onion. Suppose you take the onion and peel off the layers one after the other, looking for the real onion, of which these are only the layers. You, of course, will never find the onion by this procedure; for the layers simply are the onion. In the same way, says the actualist, if you persist in treating our "psychic states" as only states or modifications of a "self," you will never find the self. For according to actualism, such terms as "soul," "mind," "self," "personality," etc., are but names for an aggregate of psychic elements.

Substantialists have sometimes tried to score an easy victory by pointing out that even in justifying his denial of the existence of a substantial Ego the actualist is obliged to make use of terms such as "I," "my," "me," "you," etc. However effective this argument may seem at first sight, when it is examined more carefully it seems to lose its importance. For the actualist need only remind us that he is not responsible for the

language which he must employ in his exposition of his point of view. As we have already remarked, substantialism is the traditional doctrine; and as such has entered into the very structure of our philosophical and psychological speech. And the circumstance that we make use of the personal pronouns no more commits us to the substantialist position than the fact that most of us continue, in spite of Copernicus, to speak of "sunrise" and "sunset" commits us to a geocentric cosmogony.

It must be admitted, I think, that contemporary psychology inclines toward the actualist position. In the first place, introspection does not reveal a unitary self, in addition to the so-called "states of consciousness"; at best it reveals a sequence of psychic events. In the second place, the hypothesis of a substantial Ego or Self, of which the psychic events might be regarded as states or modifications, does not really explain anything. In this respect it is like the conception of vital force or entelechy, which we discussed earlier in the present chapter; the Ego, like the entelechy, is simply a name for our ignorance, a conception which, under the guise of explaining, dulls our sense of the need of explanation. In the third place, there are well-authenticated cases of forgetting one's own identity, and cases of dual and even of multiple personality, which are hard to reconcile with the dogma of a unitary self.

On the other hand, it should be said, I think, that the older actualism, in its account of the self, neglected to emphasize sufficiently the idea of *organization*. If the self is merely an assemblage of psychic elements, it is not a random, mob-like assemblage. The impressions, ideas, etc., which together constitute the self are arranged, so to speak, with reference to a center.[12] My toothache hurts me more than it does you, and your ambitions and enthusiasms are of more consequence to you than they are to me. This relation of organization, this reference of the constituents of the self to a center, is, however, a matter of degree; and the best of selves are but partially inte-

[12] It is not necessary, however, to suppose that there is anything *at* the "center."

grated; while in pathological cases of forgotten identity and multiple personality there is a measure of disintegration.

Closely bound up with the question of the unity of the self is the question whether the self is *immaterial.* We need not repeat the reasons given in previous paragraphs for rejecting the notion of mental entities which are not also physical. All mental activities, we have seen, are psycho-physical. It is not satisfactory, then, to say that the self is the consciousness associated with the organism, or even that it is the sum-total of the activities of the organism; we should say rather that *the self is the organism active and conscious.*

The Self and the Subconscious.—If the self is not a substance, but rather an organization of psycho-physical events; and if, as was pointed out in the preceding section, the "stream of consciousness" is discontinuous; we may ask the same question about the self which we asked about our ideas. Where is the self between times? Where am I when I am not conscious, as, let us say, when I am in a state of dreamless sleep? I suppose the correct answer would be to say, if we have the courage of our logic, "It is not"; "I am not." And yet there may be *degrees of consciousness;* and there may be more in the notion of the "subconscious"—if we may use this term to denote a low degree of consciousness—than was suggested by our previous discussion of the doctrine of neurograms. (See Chap. VI, p. 182.)

Indeed, one of the logical motives for the conception of the subconscious, or the "unconscious" as it is sometimes called, is a desire to preserve the continuity of the self. In order that we may avoid the necessity of admitting that we *cease to exist* when we are not conscious, we are led to postulate a sort of subconscious or "unconscious" consciousness. Thus we seek to bridge the gap which must otherwise be admitted to exist in the "stream of consciousness."

Another motive for believing in the subconscious is closely akin to this. It too depends upon a desire for continuity—not in this case for continuity within the individual self, but for continuity with other selves. Minds of a certain mystic ten-

dency, perhaps all of us in some moods, tend to rebel against the isolation and separateness of human selves; and to wish for the assurance of fundamental unity. This craving for fundamental unity may be satisfied, in thought, by postulating that what each of us ordinarily thinks of as himself is but a small part of his total self; that by far the greater part of his total self is subconscious; and that all of us are subconsciously united. Thus our little conscious selves might be likened to a series of islands, separated from each other by broad expanses of water and yet all having a submarine connection.

Neither of these arguments from continuity is very convincing, it seems to me; for they proceed from wishes rather than from sober fact. (See pp. 206 f.) There is a class of phenomena, however, which seem to require the conception of the subconscious for their explanation. I refer to phenomena such as automatic writing, sleep-walking, etc., which may be grouped together under the head of *automatisms*. Such forms of behavior we should undoubtedly regard as conscious were it not for the fact that the subject presents an appearance of complete preoccupation with something else or tells us afterward that he has no recollection of what he is said to have done. And it seems probable that such cases are examples of an imperfect integration of the self, rather than of purely physical activity.

It has sometimes been alleged that the notion of the subconscious or the unconscious is absurd, in the sense of being internally contradictory. I am not convinced, however, that this is just; for there are at least two ways in which this idea of a "subconscious consciousness" or an "unconscious consciousness" may be defined so as to avoid logical absurdity:

(1) The "unconscious" or "subconscious" may be defined as consciousness of a very low degree of intensity. Just as darkness is not the total absence of light but merely a very dim intensity of illumination, and just as cold is not the total absence of heat but merely a low temperature, so an unconscious or subconscious state is a state which is conscious in only a minimal

degree. There is assuredly no logical impossibility in the conception of the unconscious if it is defined in this way.

(2) The term "unconscious conscious state" may also be saved from logical absurdity by giving an objective significance to the first adjective and a subjective significance to the second. In other words, the phrase "conscious state" is ambiguous. It may mean a state or event [13] which is the object of consciousness, and it may mean a state or event which is the subject of consciousness. (That which is known is the "object"; that which knows is the "subject," according to the technical use of these terms.) For example, my apprehension of a chair is a subjectively conscious state; but if, besides being conscious of the chair, I am also aware that I am conscious of it, then my apprehension of the chair is not only subjectively conscious but also objectively conscious.[14] Now many, perhaps most, psychic events are conscious in both senses. On the other hand, a psychic event which is subjectively conscious but not objectively conscious would be an "unconscious" conscious state. It would be a conscious state, because it is a state of awareness (of something else). It would be an unconscious state, because no other state is aware of it.

Subconscious mental states which lack integration with the primary consciousness on account of their low degree of intensity have been called by Warren,[15] "subliminal conscious states"; while those which are of normal intensity but which are nevertheless detached from the main stream he calls "subordinate conscious states." Subordinate conscious states which have become integrated into a relatively unitary personality, which is however detached from the primary personality, are said to be "co-conscious."

[13] As explained on p. 211, the term "state" is a relic of the substantialist doctrine of the self, but as used in contemporary discussion, it need not commit us to that position.

[14] In order not to complicate the discussion unduly, the question of the strict simultaneity of these two strokes of consciousness is not raised in the text. If the reader prefers, the statement may be rephrased, "I am also aware that I *was* conscious of it."

[15] *Human Psychology*, 1922, p. 145.

Returning, then, to our question whether the self continues to exist during intervals of unconsciousness, we may say that there are *degrees of selfhood*. There seems to be no factual ground for refusing to admit that the self now and then simply ceases to exist. On the other hand, there are probably cases in which the constituents of the self fade away, as it were, into subconsciousness without entirely ceasing to be psychic; and there are also cases in which the self becomes, to a greater or less degree, disintegrated while some of its constituents remain vividly conscious.

It may be well, however, to remind the reader once more that we are dealing in this chapter with perplexities rather than with assured results of science. Indeed some of these speculations should be taken with the proverbial "grain of salt." For the purpose of a book on philosophy is not to make disciples of its readers but rather to provoke them to do some honest thinking for themselves.

8. What Is the Origin of the Individual Self?

The point of view suggested in the last few sections may however be helpful as we approach the problem of the origin of the self. But before going on to discuss "creationism" and "traducianism," the two historic answers to this problem, we must raise the question whether there really is any problem. For, according to the theory of pre-existence, each self might be regarded as eternal and there would therefore be no need for an explanation of the origin of selves.

This theory of pre-existence was widespread in ancient times. It is to be found in the Platonic dialogues, though it is not certain that Plato meant the doctrine to be taken seriously. The doctrine was taught, however, by Pythagorean philosophers and by Hindu sages. In the form in which it is usually expounded it is also known as the doctrine of "metempsychosis," or "transmigration of souls." According to this theory, at the death of an individual man his soul persists as a discarnate spirit until opportunity arises for reincarnation. Thus each one of us

may have had hundreds or thousands of incarnations. One of us may indeed have been Julius Cæsar—or one of his private soldiers. (It is amusing to notice in the literature of theosophy how many princes and princesses, kings and queens, emperors and potentates, there must have been in the ancient world, and how few slaves and private citizens!)

Some of us may think that this doctrine is too absurd to be worthy of discussion. It would not become us, however, as students of philosophy to wave it aside without giving a reason. And several objections present themselves:

(a) We have no memory of our alleged previous existences. Believers in pre-existence would say in reply that it is not safe to trust our memory in regard to this question. "Our birth is but a sleep and a forgetting," says William Wordsworth. And it is at least a statable hypothesis that we have forgotten all the experiences of our previous incarnations. They might, perhaps, remain as "unconscious" or "subconscious" memories, which are not normally subject to recall.

(b) Another objection to the hypothesis of pre-existence is the admitted fact that the population of the world is increasing. This is not very cogent, for two reasons. In the first place, according to some forms at least of the doctrine of transmigration, the souls of men may be born the next time in the bodies of animals, and *vice versa*. Accordingly, while the human population of our planet is no doubt much greater than it was several centuries ago, it is by no means certain that the total population, human and subhuman, is any greater. In the second place, it is not essential to the theory that all souls should be incarnate at the same time.

(c) A more serious objection, it seems to me, arises from the facts of heredity. It is not simply that the son resembles his parent or grandparent—this might be accounted for very simply by assuming that for the most part the souls of the departed seek reincarnation in the bodies of their physical descendants; but also that a given individual is a blend or a mosaic of the traits of his ancestors. It is hard to reconcile the observed in-

heritance of "mental" or "spiritual" qualities with the hypothesis of pre-existence. It may be objected that even so-called "spiritual" traits are determined by the structure of the physical organism, and that it is this which is inherited. But if all which we know as "temperament," "individuality," or quality of mind is conditioned by the physical organism and is not really a property of the soul, what then is this soul or self which is said to have pre-existed? Is it a mere blank, a negation? If my pre-existent Ego had none of my traits of mind or character, it is meaningless to say that it was I.

Traducianism.—If we may conclude, then, that the theory of pre-existence is not worthy of further consideration, we may turn next to the account of the origin of the self which is known as "traducianism." According to the traducian theory the soul of a man originated in the same manner as his body. Just as the body is produced from the bodies of the parents, so the soul is produced from the souls of the parents. If parallelism were combined with a substantialist theory of the self, traducianism would be a logical consequence. The embryology of the body would be paralleled by an embryonic development of the soul. The idea of an embryology of souls is, however, one of those hypotheses which can neither be proved nor disproved. It explains nothing, and if adopted would be only a cloak for our ignorance.

Creationism.—The historic rival of the traducianist doctrine was the doctrine of creation. According to this theory each individual human soul came directly from the hand of God. Creationism, however, is open to a serious ethical objection—not to mention other difficulties which arise from the point of view of explanatory science. The ethical difficulty is that, in so far as our spiritual qualities fall short of perfection, the theory confronts us with the problem of evil in an aggravated form. Traducianism, indeed, might postpone the difficulty by speaking of a hereditary taint passing down from parent to child from our first parents even until now. Creationism, on the other hand, must think of each individual soul or self as separately

produced with all its blemishes and defects, which must then be assumed to have been specifically *intended* by the Creator.

Fortunately, if we can accept the point of view developed in the previous sections of this chapter, we need not choose between creationism and traducianism. According to the conception of the causal relation which we have called naturalistic occasionalism, we may assume that when the physical organism in its prenatal period has reached a certain stage of development, the self *begins to be*. If we remember what was said a little while ago about degrees of selfhood, it becomes unnecessary to inquire concerning the precise moment—whether before birth, at birth, or after birth—when this beginning occurs. It becomes as foolish to try to tell just when the self begins to be as it is to try to specify the exact date when a boy becomes a man. Instead we recognize that just as the physical development is gradual, so too the complete arrival of the self is a process requiring years, rather than an event occurring at some definite moment.

9. Does the Self Survive the Dissolution of the Physical Organism?

Most of us, brought up as we have been in an Occidental Christian environment, have a desire for personal survival after the event which we call death. "Physical immortality"—continuing to live in one's children and their descendants—and the "immortality of influence"—the persistence after we have gone of the good and the evil which we have done—are not sufficient. We crave continued existence as individual selves. Those who say that they have no desire for survival are probably deceiving themselves. Their attitude is a case of "sour grapes."

We may, then, admit a wish for survival. But is it only a wish, or is it also a reasonable hope? A certain boy of fourteen hoped to grow to be six feet tall. Thirty years afterward he no longer hoped to be six feet tall, but when he was honest with himself he still admitted the wish.

Many of us believe in personal immortality, not because it has been proved scientifically, but on the authority of the Bible or the Church. There are many others, however, probably an increasing number, who are not satisfied with the voice of Authority, but crave a scientific demonstration of survival. They wish to discover empirical data by reference to which the hypothesis may be verified. The various societies for psychical research are chiefly composed of people of this kind.

Through the help of "mediums" they are trying to communicate with loved ones who have passed away. Sir Oliver Lodge's book, *Raymond,* contains a typical account of such a pathetic quest. When we approach the problem, however, from the sober, unemotional, scientific point of view, we find grave reasons for doubting the cogency of the "proofs" which have been accumulated.

For the "psychic researchers," eminent though many of them have been in physics, chemistry, mathematics, astronomy, or some other line of scientific research, have not, for the most part, been trained in the refinements of psychological investigation. And for some reason the mediums can always function better in darkened rooms. While fraud, conscious or unconscious, has admittedly played a disconcerting rôle in the proceedings; and some of the most convincing manifestations have been duplicated by a few expert "magicians." Finally, there is reason to think that those who have been convinced by the manifestations have been so much under the influence of the "will to believe" as to render their opinions scientifically worthless.

The problem of the survival of the self after the dissolution of the physical organism is obviously a question for decision by scientifically trained psychologists. The commonly accepted maxim, "No psychosis without a corresponding neurosis," makes it hard to believe that the mental life can continue after the nervous system has returned to dust. On the other hand, the believer may object that this maxim has not been proved; he may urge that it is only a postulate which may be valid enough

for ordinary mundane manifestations of mind but which may not hold true under other conditions.

We may close our discussion with a quotation from Professor Warren:[16] "The question whether human personality survives death and organic dissolution . . . is germane to psychology, yet it is avoided in most recent textbooks. The reason for this attitude is easily stated. Psychology in its present stage of development affords no real indication of the answer to be given. There is no direct evidence of personal survival in the phenomena of mental life. Certain analogies indeed may be cited for an affirmative view. . . . On the other hand, human personality now appears to be closely bound up with an organization consisting of neurons, and the interrelation of the separate neurons is lost at death. . . . Possibly future investigations either in psychology or in the field of psychical research will furnish conclusive, or at least satisfactory, evidence. At present scientific psychology neither affirms nor denies personal immortality."

If this be the best that psychology can say in regard to this question of personal survival, it does not seem wise to entangle our religion and our ethics more than is absolutely necessary with hopes and fears of the hereafter. Let us rather strive to live one life well; and if endless life be our lot, then so much the better!

10. Can the Reality of Telepathic Communication Be Established?

A very fascinating subject of speculation is the possibility of thought-transference without dependence upon the usual channels of communication. Many anecdotes are told which seem to prove that telepathic communication is a fact. A favorite story is the account of a dream, or of an insistent foreboding, referring to a far distant friend who was afterwards found to have been in great trouble, or to have died at the precise moment of the "psychic" experience. The reader may refer to H. Addington

[16] Warren, H. C., *Human Psychology*, 1920, p. 422.

Bruce's little book, *Adventurings in the Psychical,* for a popular account of the evidence. Those who wish to continue the investigation will turn to the publications of the various Societies for Psychical Research.

The believer in telepathy relies upon two kinds of evidence. These are (1) spontaneous occurrences of what appears to be transference of thought; and (2) experiments which seem to prove the reality of transference. Scientific psychologists, however, do not as a rule regard the evidence as sufficient. A typical statement of this attitude of scientific caution may be quoted from Professor Warren:[17] "The arguments against the acceptance of the telepathic hypothesis are as follows:

"(1) Faulty Memory: In many cases the temporal coincidence has proved on investigation to be faulty. The thought of a friend's death may have occurred some time before or after the event. In course of time we forget the discrepancy and come to believe that the two events coincided.

"(2) Chance Coincidence: The statistics are weighted in one direction. If a premonition of a death coincides closely with the event, it is remembered and reported; if not, it is forgotten. The strongest premonition the present writer ever had was in 1900, when he felt sure a cable would announce the death of a near relative. The person in question is still alive and hearty. If all such *negative* cases were reported, the ratio of fulfilments to total cases might not exceed the theory of chances. The element of 'reasonable expectation' also impairs the evidential value of certain coincidences; if a friend is seriously ill we are not unlikely to have thoughts of his death.

"(3) Collusion and Fraud: The experimental investigations . . . are not open to either of the above objections. But in many cases it has been shown, either that information is given to the 'percipient' by some accomplice through ordinary sense channels, or that the percipient himself used sensory means, such as seeing under the blindfold, exchanging one envelope for an-

[17] *Human Psychology,* 1920, pp. 419 ff. Reprinted by permission of Professor Warren and the Houghton Mifflin Company.

other, etc. . . . One important set of tests reported in good faith by the Psychical Research Society were afterwards shown to involve collusion between the percipient and her sister. . . . The sincerity of the Psychical Research Scientists is above suspicion; but the good faith of their human material is not always to be relied upon—neither is it by any means certain that the investigators are acquainted with *all* possible varieties of deception. Every new fraud and every new means of deception discovered casts additional doubt on the validity of the phenomena.

"(4) Unobserved Sensory Impulses: . . . There are many ways in which our thought may be shaped and molded by sensory indications so faint that another person fails to observe them, even though he tries his level best to pick up every clue. In certain stages of hyperesthesia the patient is able to distinguish one blank page from another through microscopic differences in texture. Slight 'imperceptible' adjustments of the vocal organs which accompany thought may be correctly interpreted by the percipient. Alternations in breathing, minute 'attitude' expressions may be read by a trained observer. . . . In many cases it seems quite possible to explain the phenomena in question by these unobserved sensory data without assuming telepathic communication.

"(5) The Trend of Evolution: The world of organisms has built up a tremendously complex mechanism consisting of receptors, sensory nerve-paths and centers, whose function is to convey and integrate impressions from the outer world. This mechanism has evolved slowly in race history, presumably by chance variation and natural selection. If some simpler means of conveyance is available, as claimed, it seems highly probable that at some point in the course of history a systematic mechanism for this would have been perfected and become a dominant factor in mental life. In other words, the fact that a complex nerve mechanism has evolved *everywhere* among the higher species is presumption against the existence of the simpler receptive mechanism involved in telepathy."

This last argument does not seem, however, to be as cogent as the others. In the first place, it would apply only in case telepathic ability is assumed to be widespread; for if it appears as a recent "mutation," there would be no ground for surprise that the ability has not been more perfectly developed, and that a complex nerve mechanism has been evolved instead. In the second place, the argument overlooks the fact that the possession of telepathic ability would only be of service to the organism in seeking adjustment to other *minds,* and that an additional receiving mechanism would be needed to guide the organism's reaction to sticks and stones and trees and precipices, and all the other aspects of the non-mental environment.

Although we must then pronounce the argument from the "trend of evolution" to be inconclusive, Professor Warren does not seem to me to need this argument; for his case has been sufficiently established by the other four. A very interesting and important series of experiments was performed by Dr. J. E. Coover of the Leland Stanford University, in which he tested the telepathic power both of the common or garden variety of human beings, as represented by students in the university, and of so-called "sensitives," in all cases with negative results. The successes in guessing lotto-block numbers and playing cards, and in telling whether the percipient was being stared at from behind, were no greater than would be indicated by the theory of probability.

The reader may perhaps object that even if telepathy has not been proved, it has not been disproved either. The answer to the objection is that all scientific work depends upon what is known in logic as the "law of parsimony." This is the principle that we should seek to explain all phenomena with the smallest possible number of postulates. Accordingly, as long as any hope remains of explaining the verified data by means of already recognized means of communication, the scientific psychologist rightly refuses to postulate an additional means of communication. Another point to be considered is that the scientist does not assign as much weight as the layman is prone

to assign to anecdotes of strange occurrences. The scientist refuses to give serious consideration to any alleged event unless the conditions under which it is said to have occurred can be reproduced by anyone who has mastered the appropriate technique.

It should be noted, in conclusion, that a great many believers in telepathy have apparently been influenced by a love of mystery for its own sake. They welcome evidence for telepathy because it seems to them to involve some sort of "supernatural" or "spiritual" agency. There is no reason to suppose, however, that if telepathy should eventually be recognized as a bona fide means of communication, it would be found to be in any peculiar sense "spiritual." It would, in all probability, receive a natural, mechanistic interpretation. For example, it might be thought of as depending, like ordinary visual perception or radio, upon some kind of wave motion in the "ether" by virtue of which brains might be made to vibrate in unison after the manner of tuning forks which have been set for the same pitch. This may seem at first to be weird enough; but in reality it would be no more "miraculous" or "spiritual" than any kind of signals whatsoever. It must be remembered, too, that the suggested explanation is as yet purely speculative, and must wait for the verification of the phenomena which are to be explained.

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PART TWO

SCIENCE, REALITY, AND VALUES

CHAPTER VIII

THREE TRADITIONAL ISSUES

Our survey of the sciences has revealed a bewildering multitude of perplexities. All of these are, in reality, problems of philosophy. There are, however, certain issues which belong in a preëminent sense to the philosophic tradition; and to three of these, in particular, we shall now direct our attention.

At first sight these traditional controversies may seem to be exceedingly remote from current ways of thinking; and it may accordingly be very hard for us to appreciate their significance. Our difficulty is due in part to the fact that mediæval and early modern thinkers employed a terminology which is unfamiliar or even repellent to our ears; and still more to the fact that these thinkers often based their reasonings upon assumptions which we, to say the least, are reluctant to accept.

Nevertheless we shall discover that these traditional disputes are not so foreign to us as they may seem. Indeed contemporary philosophical discussion is rooted in the past; and without some knowledge of these older controversies the philosophy of the present cannot be rightly understood.

1. Realism versus Nominalism

The first of these issues is perhaps the hardest of all for the twentieth-century student to take seriously. Indeed, if abstractly stated it may seem at first to be absolutely devoid of meaning. Nevertheless as we enter into the discussion we shall encounter problems of real importance, which in one form or another are always with us.

The question concerns the status of "universals" (generic ideas). In the Middle Ages those who maintained that univer-

sals are real were called "realists"; while those who refused to admit the reality of universals but insisted that they are to be regarded as mere names were known as "nominalists" (Latin *nomen, nominis,* "a name").

Analogous Issues.—As is true of most controversies, the issue was not so sharp as it might seem from our preliminary statement. The debate lasted for centuries; and there were naturally many intermediate positions, some of which might be called indifferently moderate realism or moderate nominalism. The difference between the rival schools of thought was, then, very largely a question of emphasis. Those who were chiefly interested in *wholes,* in general principles, in classes and types, were the realists; while those who laid chief stress upon parts, upon particular facts, and upon individual men, animals, and things were the nominalists.

Now the same difference of emphasis appears in various fields of contemporary discussion. We need only mention the political conflict between the collectivist and the individualist. The former glorifies the rôle of the state, and tends to regard the individual citizen or subject as existing in order to serve it; while the latter attributes all value to the individual, and is inclined to regard the state as nothing but an instrument which exists to promote the well-being of its citizens. Communism, the extreme form of collectivism, might then be said to correspond to mediæval realism; and anarchism, the extreme form of individualism, to correspond to mediæval nominalism.

Concept and Percept.—We have perhaps been going a little too fast; and before attempting a further advance it may be well to pause and consolidate our position. A realist we have said is one who holds that universals are real, while a nominalist is one who holds that they are mere names. But we have not made clear just what we mean by a "universal." Indeed, it may not be possible to arrive at a completely satisfactory definition; and if the mediæval disputants had been entirely clear as to what *they* meant by universals, there would very likely have been no controversy. In order to get the issue before us, we

may say then that a universal is a generic representation, or the idea of a class. In the language of the older psychology, it is a *concept* rather than a *percept*. For while a percept is the idea of an individual, or more accurately, of an individual that is definitely indicated or pointed out, a concept is the idea of any one of all the individuals that are included within a certain class. Another way of putting this is to say that a concept, or universal, connotes all the qualities which are common to all the members of the class in question.

For example, my idea of George Washington is a percept; my idea of a man, without specifying this, that, or some other man, is a concept. Again my idea of *this horse,* of Dobbin, let us say, is a percept; while my idea of *horse,* without restriction to any particular horse, is a concept. In other words, the distinction between a percept and a concept corresponds to the grammatical distinction between a proper noun and a common noun.

Now it is obvious that a percept may have an objective counterpart. That is to say, if the percept is veridical we assume that it refers to something beyond itself which belongs to the realm of existing things. Thus my idea of Dobbin refers to nothing less than Dobbin himself. But what shall we say of the concept or "universal"? Does the universal, too, have an objective counterpart? If I have an idea of horse-in-general, is there anything in the realm of actuality that corresponds to it? From the twentieth-century point of view, an affirmative answer suggests curious questions. For if there is a horse-in-general, what color is it? Is it large or small, etc.? Indeed, from our point of view a concept seems to be more like a blank to be filled, now in one way and now in another, than like a description of an existing thing.

The Ambiguity of the Adjective "Real."—The mediæval followers of Plato, however, were disposed to answer our question in the affirmative. Any other answer would have seemed to them to be absurd. For one of the fundamental assumptions inherited by them from their master Plato was the conviction

that the faculty of reason possesses a worth or dignity which is lacking in the case of sense-perception. If then it be agreed that percepts are real, it is unthinkable that concepts, the ideas of reason, should have any less reality. Indeed, the Platonist was likely to go even farther in his preference of reason to sense-perception. Having said (1) that the concept is just as real as the percept, he was likely to add (2) that the concept is more real than the percept, and even (3) that only the concept is truly real.

One source of difficulty in the attempt to understand what is meant by the Platonic realists is found in the ambiguity of the adjective "real." For when we are told that the universal is real, that it is more real than the individual, that the universal alone is truly real, we are constrained to ask just what is meant by the word "real." At least three different meanings may be suggested:

(a) To be real may mean to exist. In this sense, "real" is the opposite of "imaginary" or "fictitious." All physical objects are then real; and all ideas—concepts and percepts alike—are real, inasmuch as they actually exist or occur as "contents" or "acts" of some "mind." It is hard to see, then, just what was intended by the "moderate realists" of the twelfth and thirteenth centuries who contended that universals existed *ante res* (to employ the famous Latin phrase), and then interpreted this to mean that universals preëxisted in the mind of God as the archetypes in accordance with which He subsequently created particular things; for, if God is assumed to be omniscient, it would follow that the ideas of particular things must have preëxisted in the same manner.

(b) To be real may mean to refer successfully to, to "represent" a somewhat not itself, which is real in our first sense. In this second sense of the term, veridical percepts are of course real. That concepts too are real is not so clear.

(c) To be real may mean to be important, to possess dignity or worth. If the realist says that the universal is more real than the individual, or that the universal alone is really real, it is

clear that he is thinking no longer in terms of *existence* but in terms of *value*. Indeed, Platonic realism seems to have derived its plausibility and attractiveness from a confusion of these two meanings of the adjective *real* and of the noun *reality*. For if these words are used as what the logician would call "sliding terms," it is easy and natural enough to pass from the (obvious) proposition that concepts are real (in the sense of possessing value) to the (not so obvious) proposition that they are real (in the sense of referring to existents.)

Indeed, unless we suppose them to have confused existence and value, it is impossible to explain how men of great intellectual power, such for example as William of Champeaux (1070-1121), could have developed the most extreme forms of realism. For according to William, "Only genera are substances; individuals are only their attributes; manhood is essential, Socrates accidental. Moreover *every* universal is real; whiteness would be real even if there were no white thing."[1] If substance, essence, and reality connote actuality or existence, we can only reject such statements as absurd; but if these terms connote value, then the statements become both understandable and plausible.

Why the Issue Seemed So Important.—The men of the Middle Ages, however, were not interested in the dispute between the realists and the nominalist for its own sake alone. From their point of view the issue was of great importance for the reason that it was bound up with the possibility of finding a rational justification for the dogmas of the Church, belief in which was admitted by all to be essential to eternal salvation.

The "schoolmen" or "scholastics," as the thinkers of this period are often called, believed the doctrines of the Church; but in addition to believing them, they wished to enjoy the luxury of proving them, or at least of showing that they were free from logical contradiction. But if the dogmas of the Church were to be established or defended from the point of view of

[1] John Dewey in Baldwin's *Dictionary of Philosophy and Psychology*.

reason, realism must first be granted. For the acceptance of nominalism would make the rationalization of the dogmas impossible. By way of example, let us point out the realistic presuppositions of three important doctrines. We shall select (1) the doctrine of the Trinity; (2) the doctrine of the Fall and the Atonement; and (3) the doctrine of the nature and dignity of the Church itself.

Realism and the Doctrine of the Trinity.—Any brief statement of the doctrine of the Trinity is likely to be misleading. We may venture, however, to quote a few sentences from the Athanasian Creed. "Whosoever will be saved, before all things it is necessary that he hold the Catholic faith. Which faith except everyone do keep whole and undefiled, without doubt he shall perish everlastingly. But this is the Catholic faith: That we worship one God in trinity and trinity in unity; neither confounding the persons nor dividing the substance. For there is one person of the Father, another of the Son, another of the Holy Ghost. But the Godhead of the Father and of the Son and of the Holy Ghost is all one: the glory equal, the majesty coeternal. . . . So that in all things, as aforesaid, the Unity in Trinity and the Trinity in Unity is to be worshipped."

Thus, according to the orthodox teaching, the Father is God, the Son is God, and the Holy Spirit is God; nevertheless there are not three Gods, but one God. The Trinity is a Triunity and not a Tritheism. For deity or godhead is held to be a universal which is manifested in three individuals; and the relation of the Father, the Son, and the Holy Spirit to the one Godhead is regarded as analogous to the relation of individual men to humanity or man-in-general.

According to nominalism, however, universals do not really exist, but are mere names. Therefore if nominalism be accepted, the unity of the Trinity disappears and we have left the three persons, who must then be considered as three Gods. It was possible, indeed, for some of the nominalists to continue to believe in the orthodox doctrine of the Trinity, in spite of the fact that logical consistency would lead them to resolve the Trinity

into a Tritheism. Their faith was not, however, like that of the realist, a faith buttressed and supported by reason, but it was a faith which persisted in defiance of reason.

Realism and the Doctrine of the Fall and the Atonement.—Another doctrine which was less understandable on nominalistic than on realistic presuppositions was the doctrine of the fall of man and the atoning work of Christ. According to the orthodox position, the entire human race sinned when Adam ate the forbidden fruit. Each one of us, indeed, as a member of the human race, shares the guilt of Adam's sin.

Now on realistic assumptions this is easily understood; for it was not simply Adam the individual but Adam the generic man who sinned. According to nominalism, however, there is no generic man; "generic man" is a mere name. Therefore if nominalism be accepted it becomes impossible to hold anyone but Adam responsible for Adam's sin; and the whole conception of original sin and original guilt goes by the board.

Again, according to realism, Christ may be considered as a second Adam; for Christ is also generic man. Consequently, just as in Adam all sinned and thereby incurred the righteous wrath of God, so all may also share in the atoning work of Christ, and thus be reconciled with God. Nominalism, however, by its denial of the reality of the generic man, would make the idea of atonement as impossible as it would be unnecessary.

Realism and the Doctrine of the Church.—It is easy to see furthermore that the Catholic doctrine of the nature and dignity of the Church is easier to understand and to accept on realistic than on nominalistic presuppositions. For the Church too, according to realism, is a universal. And as such it has an existence independent of and prior to that of its members. On nominalistic grounds, however, the Church is nothing but an association of believers. Accordingly if there were no members there would be no Holy Catholic Church.

Realism and Pantheism.—Thus nominalism was distrusted because it tended to heterodoxy. It must not be supposed, however, that realism was a perfectly safe position, either. For real-

ism too was the outcome of a logical motive which if unchecked would lead to heresy. The logical motive of realism, as we have seen, was a preference of the class to the individual, the more general to the less general. But if this is granted without any qualification, it follows that the most general of all must be best of all, or, in the language of the schoolmen, the "most real."

Now the class which is most general of all is, of course, that which is called in logic the *summum genus,* the highest genus, *i.e.* the genus which includes everything. Thus according to the realistic logic, *horse* is more real than *Dobbin,* and by the same token *animal* is more real than *horse.* There is, however, no reason to stop with *animal.* If it be true that the more general is always more real than the less general, the class *living organism* is more real than the class *animal,* and the class which includes everything—call this class *thing* or *being*—is most real of all. If the realist then has the courage to carry his logic to the bitter end, he will arrive at the conclusion that nothing is genuinely real except Being; and if, as seems to be inevitable, this all-inclusive Being is identified with God, we are led to pantheism.

Inasmuch then as both extreme nominalism and extreme realism were found to lead to heretical conclusions, it was natural that the great ecclesiastical philosophers of the thirteenth century, St. Thomas Aquinas and his celebrated rival Duns Scotus, should occupy middle ground between the two extreme positions. According to this moderate or "Aristotelian" realism, the universals were not supposed to possess independent reality, as Plato was said to have taught, but rather to be real in the sense that they were *in rebus,* that is to say, were in things as the essence or group of common qualities, by virtue of which the things in question are members of their respective classes. The moderate realists, however, combined with this the doctrine already referred to, that in addition to being *in rebus* the universals were also *ante res* in the sense that they preëxisted as archetypes in the mind of the Creator.

The Sense in Which Universals Are Real.—The realistic position with its emphasis upon the whole rather than the part,

the general rather than the particular, the class rather than the individual, harmonized with the hierarchical and feudal organization of Church and State which was characteristic of the Middle Ages. It was natural, then, that with the weakening of the principle of authority toward the close of the mediaeval period, there should be a revival of nominalism. Thus nominalism, with its emphasis upon the individual rather than the group, and its interest in facts rather than principles, became both symptom and cause of a new era in science and philosophy.

We must not however jump to the conclusion that, because nominalism was thus the forerunner of Protestantism and the path-breaker for modern science, it is to be accepted by us as a satisfactory point of view. At any rate, we cannot be satisfied with the doctrine that universals are mere names. As we shall see more clearly in subsequent chapters, modern science is impossible unless universals are in some sense real. Unless we are to hold that the order which science describes is wholly man-made instead of being discovered, unless we are to hold that classification is merely conventional, we must insist that there is something in the realm of objective existence which corresponds to the concepts which are formed by the mind of man when it seeks to understand its world.

Conceptualism.—It may be presumptuous for us to attempt here and now to "settle" a question which agitated the keenest minds of Europe for so many centuries. We may venture to say, however, that we can accept neither the extreme realism of William of Champeaux on the one hand, nor the extreme nominalism of Roscellin and William of Occam, on the other.

Perhaps the most satisfactory position is to say that a universal is the group of qualities which are common to a number of individuals. Because they possess this common group of qualities, it is convenient to call these individuals by the same name; in other words, to subsume them under the same class. The meaning of the class-name, that is to say, in terms of contemporary reaction psychology, the set of responses which it tends to evoke when seen or heard (or merely "thought") by

the organism, is the concept. The concept, accordingly, is not real in the sense of having a *definite* objective counterpart, which exists (in the same sense in which individual things exist); but the concept is real in the sense that it exists or takes place "in the mind," and also in the further sense that it refers or corresponds to a fact outside the mind—to the fact, to wit, that certain things are so related to each other that it is usually safe to treat them all in very nearly the same way.

This is very close to the doctrine which is known historically as "conceptualism." We should add, however, that from the standpoint of contemporary psychology the difference between concept and percept is not an absolute one but rather a difference in *degree of definiteness*. For example, the responses which we tend to make upon hearing or thinking the name "man" are somewhat less definite than those which we tend to make upon hearing or thinking the name "George Washington"; but even these latter will be determined more or less by the momentary context or situation.

2. Rationalism versus Empiricism

The second of our three traditional issues concerns the source of knowledge. Where does our knowledge come from? By what faculty or process do we obtain it?

There have been two rival points of view: that of the rationalist, who emphasizes the rôle of *reason;* and that of the empiricist, who, as the name suggests, emphasizes the rôle of *experience* in the acquisition of knowledge. Just what has been meant, however, by "reason," by "experience," and by "knowledge," we shall find it rather difficult to determine. Nevertheless, even if we shall find the issue to be incapable of clear statement, it has entered so profoundly into the structure of philosophic thought that it cannot be wholly neglected.

The Rationalism of Socrates.—We may begin our discussion with a brief account of the epistemological position of Socrates (469-399 B.C.), as described in the dialogues of Plato. Socrates, we are told, differed from his long-winded rivals, the

Sophists, in that he did not make long speeches or profess to be in possession of a fund of knowledge which he could impart to his hearers; but contented himself instead with asking questions. This method of teaching was in part the expression of the famous "Socratic irony," which was an affectation of ignorance concerning the subject of discussion, together with a pretended deference to the superior knowledge of his interlocutors. His method of teaching by asking questions was also justified by the Platonic Socrates on the ground that "all knowledge is recollection." In learning anything, he said, we are simply *recalling* a part of what we knew in a previous existence.

"The soul, then, as being immortal, and having been born again many times, and having seen all things that exist, whether in this world or in the world below, has knowledge of them all; and it is no wonder that she should be able to call to remembrance all that one ever knew about virtue, and about everything; for as all nature is akin, and the soul has learned all things, there is no difficulty in her eliciting, or as men say learning, out of a single recollection all the rest, if a man is strenuous and does not faint; for all enquiry and all learning is but recollection." [2]

Just how seriously Plato wishes us to take this doctrine of the pre-existence of souls, and how literally we are to understand the claim that all learning is recollection, is not at all clear; it is evident, however, that Plato means to teach that man is not wholly dependent upon sense-perception for the attainment of knowledge.

The Rationalism of Descartes.—The same point of view appears in the philosophy of Descartes (1596-1650). He attempted to bring about a renovation of philosophy by insisting upon a method of universal doubt. His rule of procedure was to believe nothing unless it was completely clear and self-evident. Thus he set out to doubt everything which could possibly be doubted. He doubted the existence of God; he doubted the reality of the external world; he tried to doubt his own

[2] See the dialogue known as the "Meno," as translated by Jowett.

existence. But here he came to a stop; he found it impossible to doubt his own existence because, he said, to doubt is to think, and there can be no thought without a thinker.

It is not so clear that this piece of reasoning—the famous *cogito ergo sum*—is entirely cogent. But we may pass this by; for it is our chief concern at present to see how the procedure of Descartes brings us to the doctrine of "innate ideas." Having assured himself of the reality of his own consciousness, he finds within himself certain ideas. Some of these, says Descartes, are *adventitious,* they come from outside the mind; others are *factitious,* the mind makes them; still others are *innate.* These last are neither made by the mind, nor do they come to it, but they are inborn.

One might be disposed to object that, even assuming a given idea to be an original possession of the mind, it might still be false. This scruple, however, does not seem to have occurred either to Descartes himself or to those who opposed his doctrine of innate ideas. Indeed, in the thought of Descartes, the clearness and intuitive certainty of ideas constituted the proof of their innateness. And conversely, in the thought of the rationalistic philosophers of the period, ideas which on account of their widespread occurrence were judged to be innate were consequently held to be absolutely certain and indisputable.

The Empiricism of Locke.—John Locke (1632-1704) was in many respects a disciple of Descartes; but he challenged the doctrine of innate ideas. Indeed, a large part of his *Essay Concerning Human Understanding* is devoted to its refutation. Young children, idiots, and savages, Locke points out, are without some of the ideas which the Cartesians and Platonists would regard as innate. And this brings us to the famous analogy of the empiricists: the mind of a child at birth, instead of containing an original endowment of ideas, is like a blank sheet of paper. The believer in the innateness of ideas would maintain, of course, that the paper already contains visible writing. The more circumspect rationalist might say perhaps that the paper has already been written on, but with invisible ink which re-

quires the chemistry of experience to make it fully legible. The empiricist however maintains, as we have said, that the paper is blank, containing absolutely nothing. Or, to change the figure, according to the empiricist each of our minds is like a bit of wax, entirely free from any determined structure or shape, and ready to receive any impression which the seal, experience, may make upon it.

According to Locke and his disciples, then, all knowledge comes from experience. This is not the same, however, as to say that all knowledge comes from sensation; and empiricism should not be identified with sensationalism; for, according to Locke and those who are called in the wider sense empiricists, there are two kinds of experience. One of these is, of course, sense-perception; the other Locke called "reflection." The latter term, however, is likely to be misunderstood; for Locke did not mean by it what we are likely to suppose that he meant. By "reflection" he did not mean the elaboration or working over of the impressions of sense by which complex ideas are made out of simple ideas; but he meant more nearly what our contemporary psychologists know as "introspection."

Thus, according to the empiricists, all our knowledge comes from the two sources: perception, or the outer sense, which gives us a knowledge of the external world; and reflection, or the inner sense, which informs us concerning the workings of our own minds.

***A priori* and *a posteriori* Knowledge.**—Thus the issue is joined. According to the empiricist, all knowledge is said to be *a posteriori*. According to the rationalist, on the other hand, some knowledge at least is *a priori*. *A posteriori* knowledge, then, is knowledge which is derived from experience; while *a priori* knowledge is in the possession of the knower in advance of experience.

It is manifest that in this dispute a great deal depends upon the way in which we define our terms. If by *data of experience* we mean a manifold of disconnected items, and if by *knowledge* we mean nothing less than an ordered and systematic appre-

hension, it follows by definition that experience alone cannot give us knowledge. On the other hand, if knowledge is not defined so rigidly, but the name is given to any sort of apprehension whatsoever, ordered or unordered, then even the manifold of disconnected impressions of sense-perception would be knowledge. Finally, if the word *experience* be applied a little higher up, so to speak; if it be assumed that experience gives us order and relationship as well as the items which are ordered and related, then knowledge, and indeed all knowledge, may be said to come from experience.

Contemporary Psychology and the Source of Knowledge.—Immanuel Kant (1724-1804) adjudicated the issue between empiricism and rationalism by teaching that, so far as its matter is concerned, all knowledge is empirical; but so far as its form or order is concerned, all knowledge is *a priori*. Thus both the empiricist and the rationalist would be partly right and also partly wrong.

As long as we retain the point of view of the old "faculty psychology," which underlies Kant's discussion of the problem, his solution is about as satisfactory as any which can be found. From the standpoint of twentieth-century psychology, however, we feel like saying to both rationalist and empiricist, "a plague on both your houses"; for the question, as we see now, was badly put. Empiricist and rationalist alike were thinking in accordance with what we have called the "filing cabinet analogy." From this point of view there would of course be room for the question where the store of knowledge which I now possess came from. Did I acquire it all from experience, through my eyes, ears, etc., or did I have some of it prior to experience? However, if we think in accordance with the analogy of the phonograph (see p. 182), if ideas are not things which are stored away but actions which may be repeated, the old dispute loses much of its point.

For from this point of view the issue between rationalism and empiricism merges into the wider question of the relative importance of heredity and environment. Knowledge, as appro-

priate response, is conditioned by neural structure; and the neural (or other) structure of an organism at any given moment is the joint product of original endowment and of the previous activity of the organism in reaction to stimuli.

The Relation of Reason to Sense-Perception.—Finally, the dispute between the rationalist and the empiricist comes to an end when we raise the question of the relation of reason to sense-perception. Rationalist and empiricist alike have been disposed to think in terms of "faculties." They have regarded reason as one thing and sense-perception as another. A more careful analysis, however, suggests that there is no sharp line of division between perception and reason, but that the difference is one of degree only. For in perception the mind is already at work, actively organizing and interpreting the data of sense. Indeed, the notion of a datum of sensation which is not already to some degree organized and interpreted is a pure abstraction. And reason is not an additional source of knowledge, a little man within the man, so to speak, that decides difficult questions for us. Reason is but a name for a continuation of the same process of organization and interpretation which in its lower stages we call sense-perception.

3. Realism versus Subjectivism

Sooner or later every student of philosophy must face the question by what right he seeks to solve the problems of the universe. Is the mind of man competent to undertake the task? How can we know that our alleged knowledge is true? Is there really any world outside the mind? Is life but a larger dream? May it not be true that I am the only self that exists, and that all others are merely figments of my imagination? Are there not some questions which the human understanding is fitted to grapple with, and others which are utterly beyond its power?

Questions such as these are discussed in that branch of philosophy which is known technically as *epistemology*. This is a term of Greek origin which means literally "the science of knowledge." The problems of epistemology are usually grouped

under three heads. These are (1) the problem of the source or sources of knowledge, which we discussed in the previous section; (2) the problem of the relation of knowledge to objective reality; and (3) the problem of the test of truth. The last will occupy us in the chapter following this; while the problem of the objectivity of knowledge will be briefly explained in the following paragraphs, and we shall return to it from a somewhat different point of view in Chapter X.

Epistemology and Metaphysics.—The epistemological problems, considered by themselves, would rightly be regarded as of very little importance. And it must be admitted, I think, that in modern philosophy the importance of epistemology has been greatly overestimated. The problem of the relation of knowledge to objective reality, in particular, has been supposed to have a bearing upon profound issues of metaphysics. In subsequent chapters we shall give an account of the principal metaphysical tendencies. It will be helpful, however, to say here by way of anticipation that, according to the theory known as *materialism,* matter is the fundamental reality; while according to the view known as *idealism, mentalism, spiritualism,* or *immaterialism,* mind is the fundamental reality. Opposed to both of these extreme positions is the theory known as *dualism,* according to which it is impossible to explain all things in terms of but one kind of reality, whether it be called matter or spirit; but both must be recognized as ultimate and irreducible.

Now these metaphysical speculations, largely because of their real or fancied connection with the problems of religion and ethics, have always aroused the keenest and most sustained interest. And the epistemological problems have to a great extent derived their interest from their real or fancied connection with the problems of metaphysics.

Realism versus Subjectivism.—Concerning the problem of the relation of knowledge to objective reality, there have been two main theories. These we may speak of as *realism* and *subjectivism.* The latter position has also been known as "idealism" or "subjective idealism"; but if we are to discuss the

epistemological issue without prejudice we should avoid entanglement, so far as possible, with the issues of metaphysics and ethics. It will be better then to keep the term "idealism" as a name for the metaphysical doctrine which is opposed to materialism, and to employ the term "subjectivism" in epistemology. The reader will also observe, of course, that our present "realism" is not the same as the "realism" which we discussed in the first section of this chapter. That kind of realism, realism as opposed to nominalism, has been called, for the sake of distinction, "Platonic" or "scholastic" realism.

In epistemology, as in other branches of philosophy, there are many nuances of doctrine, and clear definition is accordingly very difficult; but we may say tentatively that the epistemological *realist* regards the world as independent of the knowledge process, while the epistemological idealist or *subjectivist* regards the so-called external world as mind-dependent. The realist says that sticks and stones and planets and stars would exist essentially the same whether we or anyone else knew them or not. The subjectivist maintains, on the other hand, that the nature and very existence of so-called material things are determined by their relation to mind. According to realism, the universe might conceivably exist without any mind whatsoever; according to subjectivism, if all minds should cease to exist, all so-called material things would straightway disappear too. To make the question a little more concrete, imagine a universe consisting of but one mind and three stars. Now suppose this one mind to cease to exist, or to become for the moment completely unconscious. What would happen to the three stars? According to subjectivism, the cessation of consciousness would *ipso facto* involve the annihilation of the three stars; but according to realism, the three stars might continue to exist without essential alteration even if the one and only mind had vanished.

The Strategy of Bishop Berkeley.—The responsibility for originating the view known as subjectivism or subjective idealism is usually assigned to George Berkeley (1685-1753), a native of Ireland and a thinker of remarkable ingenuity. As a

good Churchman, Berkeley was keenly desirous of refuting the arguments of the materialists, who denied the existence of God and of immortal spirits and threatened, as it seemed, to destroy the foundations of religion and morality—to say nothing of the foundations of Church and State as then by law established.

The materialists professed to be able to explain all phenomena in terms of matter and motion. Grant us the reality of matter, they said, grant us the principles of Newtonian mechanics, and we can explain everything without any reference to the agency of mind or spirit; and we can show that everything attributed to the activity of so-called immaterial agencies or powers can be accounted for as manifestations or by-products of the activity of matter. Thus, in the thought of Berkeley, at least, materialism was synonymous with atheism and irreligion; and he accordingly proceeded to turn the tables upon the materialists by exactly reversing the argument which led them to the denial of the reality of spirit.

The materialist had said, "Grant us matter and we defy you to prove that there is any such thing as mind." Berkeley said, "Grant me the reality of *mind* and I defy anyone to prove that there is such a thing as *matter*."

For, says Berkeley, all that anyone can possibly mean when he uses the word "matter" is a certain group of qualities, and these qualities are but impressions of our senses, or, as we may say, ideas. So-called material things are, accordingly, nothing but aggregates of ideas, and matter in the sense of substance is nowhere to be found.

Primary and Secondary Qualities.—Although we shall eventually find reasons for preferring a realistic epistemology, we must not be too hasty in pronouncing Berkeley's position absurd. In order to see how plausible the subjectivistic position is, it is necessary to return to a consideration of the traditional distinction between "primary" and "secondary" qualities (see above, p. 92). In the thought of Democritus, Descartes, Locke, and many others, it is supposed, as we have seen, that some of the qualities of a physical object are really nothing but sub-

jective appearances. Certain other qualities, however, are supposed to be in the object itself as well as in the mind of the beholder. Those which are merely subjective, which are not supposed to have any existence outside the mind, are known as the *secondary* qualities; while those which exist in the object itself are said to be *primary*. The qualities which are usually listed as secondary are color, sound, temperature, taste, and odor; those usually recognized as primary are size, shape, texture, mass, and motion.

Are There Any Primary Qualities?—This distinction, as we saw in Chapter IV, underlies modern theories of heat, light, and sound, at least in their classic expression. Thus the secondary quality of warmth or coolness is not regarded as a property of things; it is produced in us by virtue of the rapidity or slowness of the agitation of the molecules of which things are composed. In the same way, color is not in things but is produced by virtue of those properties of bodies which impart wave-motions of definite frequencies to the ether intervening between the bodies in question and our eyes. Equivalent statements might be made concerning sound, taste, and odor. In general, according to the commonly accepted point of view, the secondary qualities are modifications produced in us, directly or indirectly, by the operation upon our sense-organs of certain primary qualities of the object.

This was the view of Descartes and of Locke. Berkeley was more thoroughgoing. He assented to all that his predecessors had said about the subjectivity of color, temperature, etc., and then proceeded to say the same about the so-called primary qualities. The secondary qualities had been called subjective because they could be shown to depend upon the point of view of the observer and upon the condition of his sense-organs. But exactly the same is true, says Berkeley, of the so-called primary qualities. Consider size, for instance, which is commonly regarded as a primary quality. How do we gain our ideas of the sizes of things? Chiefly, it must be admitted, through the senses of sight and touch. Now it is easy to show that the visual

appearance of magnitude depends upon the position and point of view of the observer. Viewed from a mountain top, men and horses are no bigger than squirrels, and a train of railroad cars looks like a child's plaything. Or, if size is to be learned from the sense of touch, we find similar differences in accordance with the part of the body with which the thing is in contact. To mention only one example, it is notorious that to the tongue a dental cavity may appear to be of monstrous size, while as apprehended by the finger-tips the same cavity will be quite small. From considerations such as these Berkeley concludes that there are no primary qualities but that all the qualities of so-called physical objects have exactly the same status as the secondary qualities. In other words, none of the qualities of material things are really objective.

What Can We Know of Things in Themselves?—If then the so-called primary qualities are no more objective than the secondary qualities, what can be said about the "object" itself? Berkeley and his followers maintain that so-called material bodies have no existence outside our minds, but are merely groups of perceptions within our minds. (The question will be complicated a little further on when we learn that things may exist as ideas in the mind of God; but for the present we shall ignore this refinement of the Berkeleyan theory.) Immanuel Kant agrees with Berkeley in refusing to make any distinction between primary and secondary qualities. For the "primary" qualities—size, shape, motion, etc.—are spatio-temporal qualities; and in Kant's philosophy *space* and *time* are forms of sense-perception rather than properties of the real world.

Kant, however, is not a subjectivist but a realist; for he insists that there are "things-in-themselves" which are independent of the perceiving mind. Nevertheless it must be admitted that his realism is of a shadowy sort, and that in his scheme the independent world, if we may so speak, has almost evaporated. For, although he refuses to follow Berkeley in the latter's denial of the existence of physical reality, he holds that, inasmuch as all the properties which we commonly assign or

could by any possibility assign to things are determined by the structure of our own minds, we are necessarily ignorant of the ultimate nature of the "things-in-themselves." In a word, according to Kant, we know that "things-in-themselves" are; but we have no way of discovering *what* they are.

The Fundamental Principle of Subjectivism: *Esse est percipi.*—The position of Kant is known as "phenomenalism," and should be sharply distinguished from the subjectivism of Berkeley. Berkeley would no doubt have argued in opposition to Kant that there is no use in assuming the existence of something about which we have no knowledge. Indeed Berkeley bases his whole doctrine upon the principle that *esse est percipi.* Literally translated, this means that "to be is to be perceived." This translation, however, is not quite fair to Berkeley; for it would limit the meaning of *percipi* to what we now know as sense-perception. And a better rendering would be, "to be is to be experienced." Negatively, this would mean that a thing which is not experienced does not really exist. For, as has been said, a thing is simply the sum-total of its qualities; and qualities are perceptions. Tables and chairs, walls and floors, all so-called material bodies, are merely groups of ideas in our minds.

Objections and Difficulties.—Obvious objections at once occur to us. Thus it may be urged that if Berkeley is right we ought to be able to walk right through a stone wall; for if the wall is nothing but ideas, what is to hinder us? Berkeley would reply, however, that when we try to walk through a stone wall we meet ideas of hardness, of resistance, and perhaps of pain which constrain us to desist.

Again, it may be objected that if a fire is nothing but ideas, there would then be no difference between a real fire and an imaginary fire. Berkeley replies triumphantly that the only difference is one of ideas, whether on his theory or on any other. For the real fire is unlike the imaginary fire in that it includes ideas of intense heat and, if you put your hand into it, of pain, which are lacking in the case of a similar experiment with an imaginary fire.

A more serious difficulty arises from the consideration that Berkeley's theory seems to destroy the permanency of material objects. Thus consider the case of a solitary sleeper. If it be true that their *esse* is identical with their *percipi,* what becomes of the pictures on the wall when he falls asleep? What, indeed, becomes of the bed—and of the body which rests upon it? This may seem, at first, to be a "poser"; but Berkeley meets it easily. His answer is that things continue to exist as *ideas in the mind of God,* even when no finite mind perceives them or is thinking about them. In the same way Berkeley would solve the difficulty of accounting for the existence of the material universe before man appeared upon the scene. Before man was created, he says, the world existed as a system of ideas in the mind of God.

A further objection suggests itself, however. If before the appearance of finite minds the material universe existed in no other sense than as a system of ideas in the mind of God, then, whether we think in terms of evolution or of creation, the process becomes empty and meaningless. For there would be no significant difference between the created (or more completely evolved) solar system and the plan or blue prints, so to speak, previously existing in the mind of the Creator. Berkeley, with all his keenness in anticipating objections to his theory, and with all his ingenuity in meeting them, does not seem to have faced this difficulty. The only way out for the subjectivist would seem to be a denial of the reality of the temporal process, and the consequent treatment of history as an illusion.

Subjectivism and the Problem of Evil.—Berkeley, however, finds in our craving for an account of the permanent existence of material things, and of their existence prior to that of finite minds, *a proof of the existence of God.* Indeed, the influence of the Infinite Spirit upon our finite spirits is, he thinks, the *cause* of what we commonly call our sensations. Thus he successfully meets an objection which had been brought against his theory—but only, I fear, to fall into a still more serious difficulty. The objection was that if the physical world is nothing but a system of ideas, there is then no ground for the experienced

order and uniformity of natural phenomena. One might expect, it was urged, that harvest would sometimes come before the sowing of the seed, instead of always coming after it. In reply Berkeley says that phenomena occur in a regular order because the Infinite Spirit, in his beneficence, gives us our perceptions in this way, in order that we may know what to expect; and he argues with considerable force that it is more reasonable to base our confidence in the uniformity of nature upon the will of an intelligent Spirit than upon certain assumed laws of lifeless matter.

In his zeal, however, the good bishop proves too much. For his argument would make God immediately responsible for the evil as well as the good of the world. To take but one crude example from a multitude which might be adduced, let us consider the newspaper story of a young boy who, in running across a back yard in pursuit of a ball, dashed into a wire clothesline of whose existence he was previously ignorant. If Berkeley's theory be adopted, we should have to suppose that the Infinite Spirit, in His wisdom and beneficence, chose to introduce into the boy's mind, and that of his friends, sensations of resistance and then of bruised flesh and broken bone!

Subjectivism and Solipsism.—Let us return, however, to the argument by which the subjectivist seeks to prove the nonreality of material substance. It is based, as we have seen, upon the postulate that everything which exists must be describable in terms of experience. Inasmuch then as we have no experience of material substance over and above our experience of its qualities, material substance does not exist. The subjectivist fails to see that the same argument which throws doubt upon the reality of matter holds just as well against the reality of other minds. Because I can have no immediate knowledge of anything except my own ideas, Berkeley concludes that so-called matter is nothing but a system of ideas. But my knowledge of the existence of *other minds* is no more direct and immediate than my knowledge of the existence of matter. Indeed, in practice, my belief that another person is in the same room with me is an inference

from my perception of his body. If, then, his body is but a group of ideas in my mind, would it not be natural to suppose that his mind also is but a group of ideas in me?

And this would bring us to the view known technically as "solipsism," the doctrine that I alone exist. I do not suppose that any one outside of a madhouse ever entertained it seriously. Yet it would seem to follow inevitably from the premises of subjectivism. And it is a view which can be plausibly defended. For how can *I* know that *you* exist? I must admit that, if I choose to question it, there is no process of reasoning by which I can demonstrate your objective existence. I hear what I call your voice, to be sure. I see what I call your face; but what I see and hear are merely sounds and brightnesses and colors, and these are but my ideas. "You," it may be, offer objection to being treated so cavalierly, "you" argue with me; but, as long as I remain hardheaded and rigorously logical, I must admit the possibility that what I have been accustomed to call "you" may be nothing more than a group of unusually obstinate ideas within my own mind.[3]

The Solipsism of the Present Moment.—And, if we should accept Berkeley's premises, we could not stop here. The kind of reasoning which leads to subjectivism, and then to solipsism, will lead us finally to what has been called *"the solipsism of the present moment."* I cannot prove with absolute cogency that matter exists *extra mentem;* therefore I deny the reality of the external world. I cannot prove with absolute cogency that other minds exist; therefore I become a solipsist.

[3] Berkeley himself, of course, does not draw this conclusion. He is not a solipsist. Nevertheless the premise upon which his whole argument is based implies solipsism. For his fundamental premise is that we know nothing except experiences. And this proposition derives its plausibility entirely from the circumstance that at the beginning of the discussion we express it in the singular number: *I* know nothing except *my* experience. But the experiences which we attribute to God or to other human minds, assuming that I can know that there are such experiences, must then be just as truly *my* experiences as are sticks or stones or any other parts of the realm of matter. On the other hand, if I can know an experience which is not *my* experience (as, for example, God's experience or my neighbor's experience), there is no reason to deny that I can know things which are not experiences at all.

By the same token, I am unable to prove with absolute cogency the reality of *my own past;* still less can I prove the reality of my own being in the future. So far as the future is concerned, I need not argue the point; I cannot be sure that "I" will exist five minutes from now, or five seconds, for that matter, or one second. The case of the past may not be quite so obvious. For I can remember my past life; I can recall the events of yesterday, of last week, of a year ago, of ten years ago. But, mark you, *my ideas of the past are present ideas.* I have no immediate knowledge of anything except present ideas.[4] My own past, then, like so-called "matter," like what I have been accustomed to call "you," like my future, may be nothing but a system of ideas in my present consciousness. The present moment is all that I can be absolutely sure of.

The Egocentric Predicament.—This "solipsism of the present moment" may rightly be considered as a *reductio ad absurdum* of the whole subjectivistic movement. For while solipsism might be possible in a madhouse, not even a madman could seriously maintain the unreality of his own past. The impossible outcome suggests that there is something the matter with the premise from which we set forth. And the principle, or pseudo-principle, that *esse est percipi* is responsible for the mischief.

Indeed, if we examine this principle critically, we find that it is contrary to fact, or at any rate incapable of proof. For if the word *percipi* is interpreted narrowly, so as to refer only to what we know as sense-perception, then it is clear that I am able to contemplate the existence of a multitude of things which I have never perceived; as, for example, the other side of the moon or the inside of my own skull. On the other hand, if *percipi* is interpreted broadly, so as to refer to any sort of cognitive experience whatsoever, and not simply to sense-perception, then the principle is either a sheer tautology or else it is an unprovable assumption. It is true that I cannot point to anything which

[4] This, of course, is not our point of view, but that of the subjectivist. See pp. 246, 249.

has not (now) been thought of; I cannot mention anything without mentioning it. This, however, as pointed out by Professor R. B. Perry, is a "predicament rather than a discovery." "It is impossible to argue from the fact that everything one finds is known, to the conclusion that knowing is a universal condition of being." [5] And we may add, not only is it impossible to disprove the existence of things which are not known, but our frequent experience of surprise is most naturally explained by the hypothesis that things exist without being known.

The Hypothesis of an External World.—We must admit, however, that we cannot be absolutely sure of the existence of an external world. Indeed, if the sceptic demands it, we may admit that there is *nothing* about which we have a right to be absolutely sure. On the other hand, it must be recognized that there are degrees of dubiety; and when we are challenged to prove the existence of the world *extra mentem,* it is pertinent to inquire just what is demanded in the way of proof. If what is wanted is a demonstration as cogent, let us say, as that by which we prove a theorem in geometry, it is not likely that such a demonstration will ever be forthcoming. If, however, all that is required is that the existence of the external world shall be proved in the same sense in which the hypotheses of the sciences are said to have been established, the requirement can easily be fulfilled. For there are no facts of experience which are incompatible with the hypothesis of an external world; and, as suggested in the previous paragraph, such facts as the discovery of things of which we had previously been ignorant are explained more simply by the hypothesis that things exist *extra mentem* than by any form of the subjectivist hypothesis.

The existence of the external world may then be regarded as a fundamental postulate of descriptive science; and, like all postulates, it must be justified by its fertility, that is to say, by the theorems which can be derived from it.

Realism and the Externality of Relations.—We have seen that if we grant the truth of the maxim *esse est percipi,* we are

[5] See Perry, *et al., The New Realism,* 1912, pp. 11 f.

driven step by step to a denial of the independent reality of the external world, of other selves, of our own past existence. It is important to note that this maxim is a special case of a principle, or pseudo-principle, of much wider application, which we shall discuss more fully in Chapter XII (see pp. 340 ff.), when we come to consider the issue between *singularism* and *pluralism*. This more general principle is that of the "internality of relations." This is, in brief, the doctrine that relations enter into the very essence of the things which are related; so that the things are, in reality, *constituted* by their relations to other things. Each thing, accordingly, is a complex of relations. Nothing, then, can be said to have independent reality, except the Whole which is constituted by all things; for each thing depends for its nature and its very existence upon the co-presence of everything else. Thus, as we shall see more clearly in our later discussion, the acceptance of the doctrine of the internality of relations would lead us to a "singularistic" view of reality.

Now subjectivism, or as its partizans prefer to call it, "idealism," is closely allied to singularism, or "absolute idealism," to employ the more usual designation. For if all relations are internal, as is assumed by the singularist, then the *cognitive* relation, that is to say, the relation between the knower and the thing known, is internal; and it follows that the nature, and perhaps the very existence of the object of knowledge, depends upon the circumstance that it is an object of knowledge.

On the other hand, if we deny that all relations are internal, it is no longer obvious that the cognitive relation is internal. And if the cognitive relation is not internal, we must allow the possibility that entities may exist which are not objects of knowledge; and also that the nature and existence of things which, as a matter of fact, are known may not be dependent upon the circumstance of being known. In short, realism tends to ally itself with *pluralism* (see pp. 341 ff.), which holds to the externality of relations and the co-existence of a multitude of independent reals. At any rate, realism asserts the externality of the cognitive relation. It affirms that an entity may exist

without being known, and that it may become known, and again cease to be known, without essential alteration.

Realism and the Theory of Relativity.—It is often said that the theory of relativity, as developed by Einstein and his co-workers, makes a realistic view of the world impossible; for, it is asked, if everything is relative, how can there be an objective reality which is independent of the knowing mind? The inference from the theory of relativity to an idealistic or subjectivistic epistemology is, however, entirely too hasty, and seems to depend, as already remarked (see Chap. V, p. 144), upon the connotations of the word "relativity," much more than upon the actual content of the theory of relativity. It is true that we can no longer speak in quite the manner of Descartes and Locke about size, shape, mass, motion, and so on as "primary qualities." There is a sense in which all the spatial properties and all the temporal properties which common sense attributes to things are dependent upon the point of view of the observer. Having made this concession, there are, however, two points to which our attention ought to be directed:

In the first place, if spatial and temporal differences are not somehow grounded in objective reality, if they are merely forms of our sense-perception, then differences in points of view cannot exist; for, in order that observers may have different points of view, they must be separated by intervals which can only be described as spatial and temporal (or as spatio-temporal). Indeed, if there are several observers it follows that each of these, as viewed by any of the others, is a reality *extra mentem.*

In the second place, while it is true that the spatial and temporal properties of things are dependent upon the particular observer, it is not true that the properties of four-dimensional space-time are dependent upon the observer; still less is it true that that warping of space-time in a fifth dimension which accounts for gravitational phenomena is dependent upon the observer. Indeed, the relativity theory is based upon the assumption that it is possible to find *a description of reality that is the same for all observers.*

Varieties of Realism.—If then for the sake of the argument we assume that subjectivism is untenable, we should next inquire just what form of realism is to be preferred. For there are several ways of developing the general realistic position.

(a) First, we should include among our types of realistic theory the position of Kant, which is usually spoken of as *phenomenalism*. For while Kant says that the things-in-themselves are unknowable, he nevertheless attributes to them an existence which is independent of their relation to our minds. Kant's view may accordingly be spoken of as "phenomenalistic realism."

(b) We may mention next the form of the general realistic doctrine which we associate with the name of John Locke. Since Locke and his followers spoke of our ideas as *copies* or representatives of the real things, this view is known as "representational realism." It retains the distinction between primary and secondary qualities.

(c) In opposition to the preceding varieties of realism, as well as to Berkeleyan subjectivism, certain contemporary thinkers have developed a doctrine which is known as "presentational realism," or as the "New Realism." These thinkers do not admit the distinction between primary and secondary qualities, but differ from Berkeley in that they regard all the perceived qualities of things as alike *objective*. This position they reach by abolishing the category of subjectivity and affirming that at the moment of perception the percept and what is known traditionally as the "object of perception" are one and the same entity.

(d) Another contemporary tendency has been called "Critical Realism." It agrees with New Realism, as against the view of the subjectivist, that the object of perception is independent of the cognitive relation, and that there may be at any given moment entities which are not objects of perception. It differs, however, from the New Realism in insisting upon a numerical distinction between the percept and the independent entity which is the object of perception.

Epistemological Dualism.—Both the New Realism and the new Critical Realism may be regarded as attempts to restate and bring up to date the representational realism of Locke. Unfortunately Locke was a little careless in his manner of expression. Thus he says that we know nothing but ideas; and that our beliefs about the external world depend upon inferences from our ideas, which alone are the immediate objects of knowledge. It is obvious that this leaves our belief in the reality of the objective world in a somewhat precarious condition, and opens the way for the subjectivism of Berkeley.

The New Realist accordingly attempts to save the independent reality of the external world by abolishing the Lockean distinction between the percept regarded as mental and the object of perception regarded as physical. He finds it intolerable that there should be a "screen of ideas" between us and the world of objects to which the ideas refer; and holds, as we saw above, that the same "neutral entity" may belong both to the system of entities which we call "physical reality" and to the system of entities which we call a "mind."

This doctrine, sometimes referred to as "epistemological monism," would be a very attractive hypothesis if it were not for the fact of error. If all of our perceptions were veridical, it would not be necessary to insist upon the distinction between the object of immediate awareness and the object of perception. Unfortunately, however, as the Critical Realist is never tired of pointing out, not all of our perceptions are veridical, and epistemological monism is thus seen to be an untenable position. In order to account for the possibility of error, we must distinguish between the content of consciousness and that which this content represents, between our idea or percept of an object and the object itself to which the idea refers.[6]

Although the Critical Realist thus tends toward the view

[6] Another difficulty for epistemological monism arises from the obvious fact that there is always a difference of time between the moment of perceiving and that of the event perceived. For example, to take an extreme case, the "nova" which the astronomer sees to-night may be so far away that the light by which he sees it may have been hundreds of years in reaching his eye.

known as "epistemological dualism," he would nevertheless amend Locke's unfortunate account of the cognitive situation. Instead of saying, as Locke does, that we know only our ideas, the Critical Realist would insist that we have a genuine knowledge of external objects. He recognizes, however, that our knowledge of external objects is not as direct and immediate as our knowledge of our own ideas. If these latter may be said to be known "immediately" or "intuitively," we may then summarize the doctrine of the Critical Realist by saying that in sense-perception we have a genuine knowledge of external objects *by means of* an intuitive awareness of our own ideas.

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CHAPTER IX

THE TEST OF TRUTH

Not all that lays claim to the status of knowledge is really knowledge. Yet the desire to know, or to feel sure that we know, is one of our master motives. So eager indeed are many of us to find knowledge concerning which we can be absolutely sure, that we are likely to adopt one or both of two short-cuts in the pursuit of truth.

One of these devices for the speedy attainment of certainty is a passive dependence upon external authority—upon some man, some institution, some book; another is the appeal to "intuition." For it is obvious that the *feeling* of being in possession of knowledge is not dependent upon the actual possession of such knowledge. On the contrary, the sense of certainty may be cultivated. It may frequently be produced either by social suggestion or by auto-suggestion.

1. The Method of Authority

Let us not be too hasty, however, in condemning dependence upon authority. For in the task of truth-seeking, some dependence is unavoidable. Most of us have not been to Europe; consequently it is necessary that we should depend for our knowledge of Europe upon those who have been there. Few of us have an expert knowledge of medicine, or mathematics, or chemistry, or any other science; and life is too short to master them all; consequently, no matter how independent we may wish to be, no matter how earnest we may be in demanding the right to do our own thinking, we must be willing to be instructed by those who have specialized in these various fields.

Authority in Religion and Theology.—It is natural, then, that when men wish to learn about God and immortality and

man's relation to the cosmos, they should accept the "infallible" word of this, that, or the other revered authority. These are the things about which we are most keenly desirous of knowing; and also the things about which we know least. It is not surprising, then, that in this field the method of authority should have had its most notable application.

Authority in Science.—Not only in the field of religion and theology but in the sciences as well we find dependence upon authority. Most of us have obtained such scientific knowledge as we possess by the reading of books, and it seldom occurs to us that the writer of the book may be in error. The trained scientist himself has probably gained most of his knowledge by reading books; for it is impossible for everyone to verify all that he has learned. Indeed, as the sciences advance and the amount of verified knowledge is increased, it will be more necessary than it is now for the specialist to depend upon his predecessors and co-workers for many of his facts.

Authority in Everyday Life.—In less technical matters also we are accustomed to lean heavily upon others. If we are in doubt as to the spelling or the pronunciation of a word, we refer to the dictionary. We glean our information concerning the progress of events from the daily newspaper. We trust signboards and road maps for directions concerning our route when we wish to motor from one part of the country to another.

The Element of Value in the Method of Authority.—It is then the misuse rather than the use of the method which we had in mind a little while ago when we spoke of dependence upon authority as one of the "short-cuts to certainty." It is perfectly right to learn from books and teachers, if we use them and are not mastered by them. As soon however as we begin to accept without understanding, and to reason that it is our duty to believe what we are taught whether it seems plausible to us or not, we are becoming a slave to our sources. In the field at least in which we ourselves are seeking to become masters, we have no right to make such a surrender; and to do so is to be disloyal to the cause of truth.

The residuum of value in the method of authority is the fact that, in the very nature of things, the pursuit of truth is a coöperative enterprise. This fact both justifies and sets a limit to the deference which we pay to the results obtained by our predecessors and co-workers. It is well to remember however that, other things being equal, the men of the present generation are more competent to pass judgment upon most questions than those of any previous generation. For, as Sydney Smith observed, the men of our day "are the true ancients." We are older in terms of racial experience than those who lived thousands of years ago, and therefore may be presumed to be wiser. We have had the benefit of their coöperation, so to speak, but they have not had the benefit of ours.

When Authority Becomes a Hindrance.—When our authority, whether it be man or book or institution, becomes our master instead of our instrument, it becomes a hindrance rather than a help. Thus when men quoted Aristotle against the law of falling bodies which had been proposed by Galileo, the time had come for workers in natural science to declare their independence of the philosophers of antiquity. For when we are asked to assume that all knowledge has already been discovered, and that our part is but to extract it from ancient writings by more or less clever exegesis, it is time to call a halt. It is indeed more dangerous to become a disciple of a dead philosopher than of one who is yet alive; for the dead philosopher no longer learns, and more serious still, he is not in a position to defend himself against misinterpretation.

Authorities to be Used but Not to be Obeyed.—We may sum up our account of the place of authority in the quest of truth by saying that our attitude toward our sources should always be that of responsiveness to suggestion, and never that of obedience to coercion. Authorities which are alleged to be "infallible" should always be distrusted; and the demand that we yield obedience to an authoritatively proclaimed "truth"—whether this demand is made by an oracular disciple of "science," or by a churchman armed with threats of endless

doom for those who refuse to profess his ancient creed—should be rejected.

To the present writer, nothing seems more immoral than to require young people and even children to *promise to believe* what they have been taught. No one has a right to promise to believe. The only promise that we have a right to make is that we will devote ourselves wholeheartedly to the pursuit of truth, and that so far as possible our beliefs will be determined by the evidence.

Suppose for example that a treatise on chemistry, physics, astronomy, or some other science should be found to contain statements which run counter to the results of observation and experiment. What would be the proper course of action? Must we continue to accept all that is found in our textbook on the ground that it was written by a very learned man and approved by some highly endowed institution; or is it our duty to adjust our scientific beliefs to the evidence?

To ask such a question is of course to answer it. But suppose that the statements which are at variance with the results of investigation are contained in the Bible, and that they have been approved by the Church. What should we do then? Here again there can be only one answer; all questions of science and philosophy—that is to say, all questions in which the human mind is interested—must ultimately be decided in the light of the evidence. The question must always be, not who teaches the doctrine, but by what facts is it supported? For as soon as we get beneath the surface of things we find that men, books, and institutions, however venerable, are at best but reporters of the evidence upon which beliefs and opinions may be based. Their statements possess authority in so far as they agree with the data of experience, and no further.

2. The Appeal to Intuition

Experience, however, requires evaluation and interpretation. The appeal to experience accordingly, as this term is commonly understood, is at the same time an appeal to reason. Thus the

issue is joined between reason and external authority. There are some thinkers, however, who are disposed to appeal from both reason and authority to what they call "intuition."

At the present time this seems to be the characteristic attitude of many who are called "liberals," in contrast to the authoritarianism of the so-called "fundamentalists." The test of truth, we are told, is not to be found in Church or Bible, but rather in the heart of each believer. In a few cases individual believers have reported the enjoyment of periods of absorption, as it were, into the bosom of Infinite Being, when they experienced the most intimate communion with Deity. This form of intuitionism is known as "mysticism."

It must not be supposed, however, that the field of intuition is to be limited to questions of religion and theology. There are many men who profess to be guided in matters of everyday life, such as making investments, accepting positions, employing assistants, etc., by what they call "hunches," by which they seem to mean feelings of certainty arrived at they know not how. Dependence upon such unreasoned judgments is said, indeed, to be characteristic of many of the men who have become eminent in industry and politics.

The vogue of intuition, whether in religion and theology or in everyday life, has been increased as a result of the influence of Bergson, a contemporary French philosopher. If this were a dead world, says Bergson, if reality were static, conceptual thought would be sufficient; but in a world of life, motion, and change, reason is not enough. "Life and consciousness cannot be treated mathematically, scientifically, logically . . . philosophy is and must remain a direct vision of reality, . . . an intuition. Intuition is life, real and immediate life envisaging itself."[1]

Extra-Territoriality in the Realm of Ideas.—Poetical and attractive as we may find the doctrine of intuition, at least upon a first acquaintance, it is not permanently satisfactory. For in practice it leaves us no test of truth. Questions of science, of

[1] Thilly, F., *History of Philosophy*, 1914, p. 579.

economics and politics, of the practical affairs of life, are to be decided, it would seem, in the court of reason. Questions of religion, morals, and perhaps philosophy are however to be decided by another tribunal, by that immediate insight into truth which is called "intuition." Now this would obviously introduce a sort of extra-territoriality into the realm of ideas; and it is doubtful whether extra-territoriality would be any more satisfactory as a permanent arrangement in the domain of discussion than it has been found to be in the realm of government.

Intuitionism and Empiricism.—Historically intuitionism is affiliated with the doctrine of *innate ideas,* and therefore with the point of view known as "rationalism."[2] Contemporary intuitionists, however, are inclined to commend their position to us as an example of the point of view of empiricism. "You wish," they say, "to make experience the test of truth. Well, let us call your attention then to the insight of the great mystics, to their experience of the spiritual significance of reality, and even to the ordinary man's convictions which come to him he knows not how. These immediate judgments are just as truly instances of experience as are perceptions received by means of the eye, the ear, and the sense of touch."

The contention is plausible, for it is partly true. Like all half-truths, however, it is more dangerous than a whole falsehood. For intuitionism differs from a genuine empiricism, which as we shall see a little later is indistinguishable from a genuine rationalism, in that it seeks to play favorites among different types of experience. A genuine empiricism would give the cognitive experience of the mystic, as well as those immediate judgments which are known as intuitions, exactly the same consideration which it grants to any other type of experience. It would not however treat any type of experience as more important or as having a better *prima facie* claim to truth than any other. In other words, a genuine empiricism would not share

[2] For an account of the different meanings of the term "rationalism" see p. 275.

the intuitionist's prejudice in favor of *immediacy*. For in the first place it is very probable that none of our so-called intuitions are nearly so immediate as they seem to be; and in the second place, even if they were, it would not follow that they ought therefore to be accepted without corroboration. In short, there is no ground whatsoever for the assumption that "immediate experience" is necessarily veridical.

Intuition versus Reason.—And if this assumption is rejected, there remains no ground whatsoever for the claim that intuition is superior to reason. It is hard to see why convictions arrived at we know not how should be more highly esteemed than those which can be justified step by step. The prejudice may perhaps be accounted for as a survival of the old idea that what cannot be explained ought therefore to be regarded as supernatural or in some peculiar sense divine; and we may hope then that as we gain a better understanding of the psychology of so-called intuitions it may become easier for all of us to see that they have no peculiar claim to acceptance without corroboration.

In other words, no cognitive experience is to be regarded as revelatory of reality just because it seems to be "immediate." The rightful authority of any given intuition, like that of "external authorities," and like that of the data of sense-perception, is suggestive rather than coercive. Intuitions, indeed, are frequently found to be in disagreement with other intuitions or with the data of sense-perception. In such cases of conflict there is need of some method by which we may be enabled to decide between rival knowledge-claims.

Now *reason* is nothing but this process of comparing and evaluating the data of immediate experience. "Reason" and "intuition" then are not "faculties" of the mind, to be set over against each other and acclaimed by their respective partizans as rival sources or criteria of truth. On the contrary, reason is, properly speaking, but a name for the whole mind active; and the injunction to trust our intuitions, to be satisfied with those convictions which come to us we know not how, is in

its practical effect an exhortation to use only a part instead of the whole of our intellectual equipment.[3]

3. The Employment of Hypotheses

The scientific investigator is satisfied neither with so-called infallible authorities, nor yet with private intuitions; instead, he employs the method of hypothesis. A hypothesis is a supposition which is advanced in order to explain a group of facts. These hypotheses may be found in the literature of the science, or they may be produced by the "scientific imagination" of the worker himself. In either case they are adopted only tentatively; they are valued only in the degree in which they explain the relevant facts. The true scientist does not become a champion or a partizan of any particular hypothesis; but he prefers the one which explains the relevant facts the most simply. It is for this reason, and for this reason alone, that science prefers the Copernican to the Ptolemaic theory of the universe; the dynamic theory of heat to the "caloric" theory; the wave theory of light to the corpuscular theory; the evolutionary account of the origin of species to the theory of special creation; etc., etc.

The Tentative Character of Scientific Theories.—The attitude toward truth which we have attributed to the scientist is of course the ideal which scientists recommend to each other. Actual scientists, being human, frequently fall far short of it. They become champions and partizans; they have their loyalties; they divide into schools and tendencies. In so doing, however, they become somewhat less than real scientists. And in fairness it must be said that among no body of men is there a greater loyalty to truth as such, in contrast to petty loyalties to parties and factions and tendencies, than among the workers in the various special fields of natural science.

[3] Insistence upon the recognition of intuition as a test of truth seems to be due to a confusion of thought. The confusion consists in a failure to observe the distinction between *proposing* and *disposing*. Intuition may properly be said to propose candidates for acceptance as true; self-evidence, or obviousness, creates a *prima facie* truth-claim. But this is the most that can properly be said for it. The *decision* between rival truth-claims must depend upon reason.

Theologians and litterateurs have been disposed to point the finger of scorn at the scientist on account of the rapid succession of scientific theories which have passed across the stage in the last two centuries. In reply to this taunt two things should be said. In the first place, discarded theories are not as a rule as completely abandoned as may be supposed. It is usually the case that certain elements of the old theory are taken up, as it were, into the new theory by which it is superseded. Instead of speaking then of the discarding and abandoning of scientific theories, it would be more accurate to speak of their revision and reconstruction. In the second place, what is thought by the scorners of contemporary science to be its shame is in reality its chief glory. It is to the credit of contemporary science that when new facts render old theories untenable, the latter are abandoned or revised so as to fit the facts. And it may be suggested that if in certain other departments of human thought there were a greater willingness to treat inherited dogmas as hypotheses, there would be abandonment and reconstruction in those fields as well as in the field of natural science.

Ideally, then, all scientific theories are regarded as hypotheses. Some of these are so firmly established that we are disposed to speak of them as "facts"; others are merely "working hypotheses"; the status of still others is intermediate between that of facts and that of working hypotheses. But all alike are hypotheses in the sense that they stand or fall by reason of their success or failure in accounting for the data of observation and experiment. Even the hypothesis that the earth is round would be given up if facts should be discovered that are irreconcilable with it.

4. Pragmatism and Instrumentalism

The method of hypothesis is essentially the same as what we shall call the rationalistic test of truth. Before going on to a discussion of rationalism it will be helpful, however, to touch briefly upon a point of view which is sometimes regarded as opposed to the rationalistic account of truth; but which is in

reality in essential agreement with it. This is the point of view known as "pragmatism."

Pragmatism may be described in a half-dozen words as the doctrine that *the truth is that which works.* It seeks to get away from hair-splitting distinctions and from cloudy speculations. It values only such ideas as are practical, as serve human purposes. In many respects a characteristically American point of view, pragmatism is closely allied with utilitarianism in ethics, and with the emphasis upon vocational training in educational theory.

It must not be supposed, however, that pragmatism is a completely developed and definitely worked-out system of thought. On the contrary, the term suggests a number of loosely interconnected doctrines. Thus Professor Lovejoy has distinguished "thirteen pragmatisms," thirteen logically distinct positions, each of which has gone by the name of "pragmatism." [4]

The Pragmatism of Charles S. Peirce.—We shall not attempt to discuss these thirteen variants of pragmatism, some of which are obviously untenable, while others are valuable points of view—but shall content ourselves with a few remarks concerning the movement as a whole. The pragmatic movement began with a series of articles, written by Charles S. Peirce, which appeared in the *Popular Science Monthly* in the year 1878. The general title of the series was, "How to Make Our Ideas Clear." In these articles Peirce's principal thesis was that to make our ideas clear we should inquire what would be the practical consequences of believing them; for if an idea has no practical consequences it is an empty notion, and if ideas which seem to be different have identical consequences they are not really two ideas but one and the same.

The Pragmatism of James and Dewey.—This point of view, together with the word "pragmatism," was taken over by William James. He maintains that "every difference must make a difference." We thus have a test by which the importance or unimportance of philosophic issues may be de-

[4] See *The Philosophical Review*, 1908.

termined. If the practical consequences of accepting one theory are in no wise different from those which follow from the acceptance of another, then according to James the dispute has no significance.

With this "pragmatism of Peirce" James, however, combined a theory of truth which Peirce was unable to accept. It is the theory that practical consequences may be taken as the test of truth, and even as the meaning of truth. We shall return to this point in a subsequent paragraph. We shall find that the doctrine as originally presented by James is easily misunderstood; and that, as he himself subsequently interprets it, pragmatism as a doctrine of the test of truth becomes *pragmatically* indistinguishable from rationalism.

A somewhat different emphasis is given to the general pragmatic doctrine by John Dewey. His principal thesis is that philosophy must turn from questions of epistemology and speculative metaphysics to a consideration of social relations. Inasmuch as Dewey thinks of ideas as instruments for the attainment of human ends, his variant of pragmatism is known as "instrumentalism."

Knowledge as Means and as End.—It is a good thing for the philosophic world to be reminded now and then of the danger of becoming involved in barren logomachies to the neglect of problems of vital human interest and importance. In this respect the influence of James and Dewey has been, I think, very wholesome. In some quarters however there has been a tendency to interpret the pragmatic position in such a way as to rule out of order, so to speak, as unimportant and therefore unworthy of serious discussion almost all that has gone by the name of metaphysics and epistemology. And this seems to be an unfortunate development of the general doctrine.

For while there is much to be said in favor of the instrumental theory of knowledge, the theory can easily be carried so far as to be obviously untenable. Human thinking may rightly be described as *problem-solving;* but we must not overlook the fact that men consciously make problems and puzzles for the

sheer joy of solving them! As a matter of obvious psychological fact, for most human beings at least, knowledge is an *end* just as truly as it is a means. Normal human living is and ought to be more than mere animal existence. Our primitive ancestors managed to survive without very much in the way of music, painting, poetry, science, philosophy, and the other elements of the higher life; and we and our descendants could no doubt do so too if necessary. No one, however, would seriously contend that life should thus be reduced to its beggarly elements. And if music, painting, poetry, and the other arts are to be regarded as rightful ends and goals of human endeavor, there is no sound reason for refusing to grant the same dignity to pure science and philosophy.

Practical Consequences and the Test of Truth.—It is impossible to discuss a topic so complex as pragmatism without straying off into by-paths. Let us now, however, return to the problem which is central in our present chapter, the problem of the test of truth. James teaches, as we have seen, that an idea is true if it leads to satisfactory consequences. It is true "if it works." "The true is the name of whatever proves itself to be good in the way of belief, and good, too, for definite assignable reasons." [5] " 'The true,' to put it very briefly, is only the expedient in the way of our thinking, just as 'the right' is only the expedient in the way of our behaving." [6]

Thus pragmatism, as expounded by James, would make the practical consequences of an idea the test of its truth. If the consequences are good, useful, expedient, beneficial, satisfactory, the idea is true. Now these adjectives may be interpreted in such a way as to make James's account of truth perfectly safe. The idea is true if it is useful or expedient *for the specific purpose of effecting an organization of our experience.* In other words, *the idea is to be regarded as a hypothesis,* and to say that it is a good idea, that it gives satisfaction, has value, is expedient, etc., is equivalent to saying that it is a good hypothesis. James, however, in his enthusiasm employs illustra-

[5] *Pragmatism,* 1907, p. 76. [6] *Ibid.,* p. 222.

tions which suggest a less restricted sense of the goodness or expediency of the idea which the pragmatist would have us regard as synonymous with its truth.

Consider, for instance, the idea of the house at the end of the path. "If I am lost in the woods and starved," says James,[7] "and find what looks like a cow-path, it is of the utmost importance that I should think of a human habitation at the end of it, for if I do so and follow it, I shall save myself. The true thought is useful here because the house which is its object is useful."

Now with all deference to one who was probably the most influential philosopher of his generation, it must be admitted, I think, that this illustration is extremely unfortunate. For it certainly suggests, to say the least, that the idea of the house is true because when we reach the house we shall find food and shelter. It suggests that ideas are true if they are useful in the sense of contributing to survival in the struggle for existence. Now this was not James's real doctrine. All that he really means to say, apparently, is that the true thought of the house is useful inasmuch as it agrees with the visual and other experiences which we subsequently obtain on the assumption that the house is really there.

As Dewey remarks,[8] "Mr. James is charged with . . . arguing that since true ideas are good, any idea if good in any way is true." This charge is due to a misunderstanding; but the misunderstanding is not entirely the fault of the critics. For at times, continues Dewey,[9] "*any* good which flows from acceptance of a belief is treated [by James] as if it were an evidence, *in so far,* of the truth of the idea. This holds particularly when theological notions are under consideration. . . . If an idea leads to consequences which are good in the one respect only of fulfilling the intent of the idea (as when one drinks a liquid to test the idea that it is a poison), does the badness of the consequences in every other respect detract from the verifying

[7] *Ibid.*, p. 203.
[8] *Essays in Experimental Logic,* 1916, p. 318.
[9] *Ibid.*, p. 319 f.

force of consequences?" The question must, of course, be answered in the negative. For the hypothesis which is to be tested is the idea that the stuff is poisonous. Therefore if the drinker dies, the hypothesis *works,* and from the standpoint of the pragmatist, the consequences are therefore to be regarded as *good.* The badness of the consequences in other respects is simply irrelevant.

This at any rate is the meaning of the pragmatic test of truth as interpreted by Dewey. The idea is considered as a hypothesis, and the "practical consequences" by which it is to be tested are simply the agreement or non-agreement of the hypothesis with subsequent experience. This is also the view of James—at least in his more careful moments. "Ideas become true," he says,[10] "in so far as they help us to get into satisfactory relations with other parts of our experience." Here he obviously has in view a quite specific sort of satisfactoriness, and not satisfactoriness in general. Again,[11] "True ideas are those that we can assimilate, validate, corroborate and verify. False ideas are those that we can not."

The charge that according to pragmatism any and every sort of satisfaction whatsoever might be taken into account in determining the truth or falsity of an idea was therefore due to a misunderstanding. It is not unfair to say, however, that it was precisely this misunderstanding which gave pragmatism its vogue. James had given the impression that his theory of truth was somehow favorable to a religious view of the world. He had written,[12] "If theological ideas prove to have a value for concrete life, they will be true, for pragmatism, in the sense of being good for so much." He had conceded that the doctrine of the Absolute "yielded religious comfort to a class of minds," and had added that "As a good pragmatist, I myself ought to call the Absolute true 'in so far forth,' then; and I unhesitatingly now do so." Accordingly pragmatism was acclaimed as a point of view which would save traditional theology

[10] *Pragmatism,* 1907, p. 58.
[11] *Ibid.,* p. 201.
[12] *Ibid.,* p. 73.

from the onslaught of rationalistic science and philosophy; and it was affirmed, on the authority of William James, "the eminent Harvard professor," that any doctrine which gives men æsthetic or emotional satisfaction, any doctrine which is comforting and edifying, any doctrine which "works," in the sense that it makes men better to believe it, may therefore be believed, even if by the old-fashioned logic it cannot be established. As Dewey observes,[13] pragmatism was "accepted by those whose own notions were thoroughly rationalistic in make-up as a means of refurbishing, galvanizing, and justifying those very notions."

This, however, was a perversion of James's doctrine; and in the preface to his *Meaning of Truth* he protests that, "One of the accusations which I oftenest have to meet is that of making the truth of our religious beliefs consist in their 'feeling good' to us, and in nothing else." This, of course, was never his intention; and he tells us in his later work that when he spoke of "satisfactions" in his discussion of the test of truth, he had in mind not æsthetic or emotional or religious satisfactions but *logical* satisfactions.

If we succeed, then, in penetrating beneath the fog of overstatement and the dust of controversy and misunderstanding, we find, in the movement of thought represented by Peirce, James, and Dewey, the genuine insight that the method of hypotheses employed in the natural sciences ought to be carried over into all fields of discussion. "Pragmatism as attitude," says Dewey, "represents what Mr. Peirce has happily termed 'the laboratory habit of mind' extended into every arena where inquiry may fruitfully be carried on. A scientist would, I think, wonder not so much at the method as at the lateness of philosophy's conversion to what has made science what it is. Nevertheless it is impossible to forecast the intellectual change that would proceed from carrying the method sincerely and unreservedly into all fields of inquiry. Leaving philosophy out of account, what a change would be wrought in the historical

[13] *Essays in Experimental Logic*, 1916, p. 323.

and social sciences—in the conceptions of politics and law and political economy!" [14]

5. Rationalism

It is unfortunate, however, that the pragmatists have chosen to give to the point of view with which their philosophic gospel is contrasted the names "intellectualism" and "rationalism." The fact that pragmatism has been commonly regarded, both by its defenders and by its critics, as a form of "anti-intellectualism" or "anti-rationalism" has no doubt been one of the reasons for the misunderstandings referred to in previous paragraphs. And when, in protesting against these misunderstandings, its authors have duly qualified and explained the pragmatic theory of truth, it is found to be neither anti-rational, anti-intellectual, nor anti-logical.

It is important, however, that we should make clear in what sense we are using the term "rationalism." For it has been employed historically in at least three closely interrelated and yet different senses. "(1) By rationalism we mean the attitude which makes reason instead of revelation or authority the standard of knowledge. In this sense, all modern systems of philosophy are rationalistic; indeed, it is this characteristic which enables us to classify them as modern. . . . (2) We may mean by rationalism the view that genuine knowledge consists of universal and necessary judgments, that the goal of thought is a *system* of truths in which the different propositions are logically related to one another. This is the mathematical notion of knowledge which is accepted by nearly all thinkers as the ideal; whether they believe in the possibility of reaching it or not, they consider only such knowledge genuine as conforms to the mathematical model. (3) The question is also asked concerning the *origin* of knowledge, and this receives different answers in modern philosophy. . . . [The view that] genuine knowledge cannot come from sense-perception or experience, but must have its foundation in thought or reason . . . has

[14] *Ibid.*, p. 306.

been called rationalism; though some writers prefer to name it intuitionalism or apriorism." [15] "Empiricists," continues Professor Thilly, "may accept rationalism in the first and second senses. . . . If by empiricism is meant that our world of experience is the object of philosophy, that philosophy has to interpret the world of experience, then all modern philosophy is empirical. If we mean by it that we cannot know without experience, that *pure* thought, or thought absolutely independent of sense-perception, is impossible, then, again, modern philosophy is largely empirical."

With these distinctions in mind, it is manifest that the pragmatists' polemic against "rationalism" has point only so long as rationalism is taken in the third (or to a less degree when it is taken in the second) of the three senses distinguished in the preceding paragraph. If it is clearly recognized that the problem of the *source* of any given item of knowledge or alleged knowledge is one question, and that of the *standard* by which we may determine its truth or falsity is another and a wholly different question, the apparent opposition between the pragmatic and the rationalistic theories of the test of truth vanishes into thin air. (See, however, pp. 281 f.)

Locke's View of the Test of Truth.—John Locke has been classified by the historians of philosophy as an empiricist. This is justified, however, only from the point of view of the problem of the *origin* of knowledge; for from the point of view of the test or standard of truth, Locke would have to be called a rationalist. Thus he says,[16] "Knowledge then seems to me to be nothing but the perception of the connection and agreement, or disagreement and repugnancy of any of our ideas. In this alone it consists. Where this perception is, there is knowledge; and where it is not, there, though we may fancy, guess, or believe, yet we always come short of knowledge." And what is true of Locke is true of the other great empiricists:

[15] Thilly, F., *History of Philosophy*, 1914, p. 253.

[16] *Essay concerning Human Understanding*, Open Court, 1905, Book IV, Chap. I.

it would be unfair and grossly misleading to speak of them as "anti-intellectualists," or even as "anti-rationalists."

The Coherence Theory of Truth.—The rationalistic theory of the test of truth is then the view that an idea or proposition is true if it hangs together with all the rest of our accredited ideas. This has also been called the "coherence theory." It is based upon the assumption that if two ideas are inconsistent they cannot both be true; while if a new idea is found to be consistent with all of our previously accepted ideas, it is likely to be true.[17] A psychological account of the matter would be to say that we build up our system of ideas in such a way as to retain as many of the data of experience as we possibly can; but if new experiences—whether they be data of sense-perception or "intuitions"—are found to be logically incompatible with those which have already been accepted, they are usually rejected as "illusory" and unreal. Thus a new experience is treated as real or true if it is found to be *organizable,* that is to say, if it can be incorporated into the existing system of knowledge.

Coherence and Correspondence.—The reader may be disposed to object, however, that a given proposition is true because it *corresponds to reality.* If I say that there are three chairs on the lawn, and that one of them is between the others, my statement is true if there really are three chairs, and if they really are so placed that one is between the other two. The doctrine that an idea is true if it is a good copy of the object to which it refers, and that a proposition is true if it agrees with reality, has been known as the "correspondence theory of truth"; and it has often been regarded as a rival of

[17] It must of course be admitted that we never get beyond probability. Inasmuch as the human mind is finite, it can never grasp more than a small part of the knowledge which would be relevant in any given case. Accordingly it is always possible that we shall later meet with experiences which will be inconsistent with what now appear to be verified truths; or if we never have such experiences, it is possible that other minds may have them. In other words, our test of truth is based upon the assumption that what we *are* able to experience may be regarded as representative of those aspects of reality which we are *not* able to experience. (See p. 378; also pp. 426 f.)

the coherence theory which was outlined in the previous paragraph. This, however, seems to me to be unfortunate. For the two theories are not so much opposed as supplementary accounts of truth. The "correspondence theory" is an account of the *meaning* of truth; the "coherence theory" is an account of the *test* of truth. "Ideas and propositions are true if they agree with reality. This is what we *mean* by their truth. On the other hand, the only way we have to assure ourselves that this correspondence with reality exists is to show that the item of knowledge which is in question coheres with other knowledge. . . . Of course, we can never be absolutely sure that coherence is an index of correspondence with reality. And the skeptic is at liberty to make what he can of this admission. We can only postulate that the agreement of our ideas with one another is an evidence of their truth." [18]

Distinguishing Genuine Percepts from Illusions.—Whether or not the fact that a new experience coheres with previous experience gives us a logical right to be certain that the new experience is veridical—to this question we shall return in the next chapter—it is the only test that we have. It is as if I were challenged to decide whether a given picture is a good likeness. Having never seen the person of whom the given picture is said to be a likeness, I compare it with a hundred other pictures which are commonly regarded as portraits of the person in question. If it differs markedly from all the others, I pronounce it spurious; while if it agrees with them in all important respects, I say that it is probably authentic.

In a manner not essentially different from this we decide whether particular items of experience are to be regarded as "illusions" or as genuine percepts. The appearance of a face in the fire is illusory, we say, because the idea of the face and the idea of the fire are incompatible. The stick which is half in air and half in water is not really bent, because the idea that it is bent is incompatible with the way it feels when I run my hand along it and with the way it looks when I pull it

[18] Dotterer, R. H., *Beginners' Logic*, 1924, p. 323.

completely out of the water or thrust it completely under the water. The extension of the restaurant which I see filled with tables surrounded by diners is not real; because upon closer inspection I see that person for person and object for object it is the same as the portion of the room in which I am sitting. The "rats" seen by the drunkard in delirium are imaginary; for other people do not see them. And in general whenever you condemn an alleged datum of sense-perception as illusory or hallucinatory or in some sense unreal, your judgment is based upon a comparison of the datum in question with other data of sense-perception. In other words, the genuine percept coheres with the rest of our experience, while the illusion or hallucination does not.

The Method of Hypotheses Illustrates the Coherence Theory.—It is obvious that the coherence theory of the test of truth is presupposed in the rejection or verification of hypotheses. Of two given hypotheses, we prefer the one which gives the simpler explanation of the same or of a larger group of facts. This is only another way of saying that the hypothesis is true if it agrees with the data of experience.

Pragmatism a Form of the Coherence Theory.—Inasmuch as pragmatism, considered as an account of the test of truth, is but a generalization of the scientific employment of hypotheses, it is inevitable that we should now treat it as a form of the coherence theory. Indeed, the clearest and most persuasive explanation of the principle that coherence is the test of truth is to be found in the writings of William James. I can quote only a few of the shorter passages: "Ideas (which themselves are but parts of our experience) become true just in so far as they help us to get into satisfactory relation with other parts of our experience." "New truth is always a go-between, a smoother-over of transitions. It marries old opinion to new fact so as ever to show a minimum of jolt, a maximum of continuity." "A new opinion counts as 'true' just in proportion as it gratifies the individual's desire to assimilate the novel in his experience to his beliefs in stock." [19]

[19] *Pragmatism*, 1907, pp. 58 ff.

Distinguishing Dream and Fiction from Real Experience.—It may occur to the reader to object that, if coherence is our only test, we have no way of telling whether we are dreaming or awake. The only answer to this objection is to say that of two given systems of experience, both of which are internally consistent, but which are incompatible with each other, we assume that the more extensive system is more likely to be real. Now, inasmuch as our waking experience, day after day and year after year, is for the most part organizable into a consistent whole, while our dream experiences are usually inconsistent with each other as well as with this larger whole, we have no difficulty in making the distinction, or in deciding which is to be considered real.

The same assumption enables us to meet the objection that, according to the coherence theory, a consistent piece of fiction would be true. "For instance," says Professor Patrick,[20] "Johnny's mother tells him not to go swimming; but he goes and then tells her that he did not go, and then, buttressing his statement with that of his pals, builds up a chain of evidence to support his lie that makes it seem to his mother to be a coherent and consistent system, his own statement fitting in perfectly with all the other elements in the situation. All the parts of this system are coherent, and yet we could not say that the various statements are true." The solution of the difficulty, of course, lies in the fact that, while the system of statements made up by the boy and his pals may be *internally* consistent, it would not be consistent with their own recollections of what had actually taken place, and would thus be at variance with the larger whole of which all true systems must be parts. The mother may, of course, have been deceived—our test of truth is not infallible—and she would remain deceived until she should happen to discover some inharmonious item of experience, some lack of continuity between the cleverly constructed bit of fiction and the larger whole of organized truth.

[20] *Introduction to Philosophy*, 1924, p. 390.

6. Science and the Mathematical Ideal

Our only test of truth is, then, coherence. A given idea or proposition is true if it fits in with the rest of our ideas and propositions. There are, however, two levels of coherence. Thus far in the present chapter we have thought of coherence in the sense of mere *consistency;* but there is another, and so to speak a closer type of coherence, which is called *implication.* Here we recall what was said in the last section of Chapter IV about the mathematical ideal in science and philosophy. In a mathematical system, it is not enough that the theorems shall be consistent with each other; they should also be related in such a fashion that each theorem *is implied by* the ones that went before, so that the entire body of doctrine can be shown to follow with rigorous logical necessity from a few fundamental propositions which are called axioms.

Now science seeks, wherever possible, to substitute the relation of implicativeness for that of mere consistency. Where this can be done we feel that we have a more rigorous test of truth than is afforded by coherence of the looser sort; and we should like, if we could, to have all our knowledge so expressed as to constitute a system of truths in which the different propositions are logically related to each other.

This at any rate is the attitude of those who are believers in Professor Thilly's second kind of rationalism (see p. 275). As he remarks, this mathematical notion of knowledge is "accepted by nearly all thinkers as the ideal." It seems to me, however, to be an unfortunate over-statement when he suggests that we should "consider only such knowledge genuine as conforms to the mathematical model." To insist upon this would, I think, be an excess of rationalism. It is one thing to say that we should wish, if we could, to have all our knowledge organized in accordance with the mathematical model; it is a quite different thing to say that so-called knowledge is not genuine unless it be thus organized. Indeed, if we should adopt this ultra-rationalistic position—a position against which the protests

of the pragmatists would be fully justified—we should have to admit that very little which we have been in the habit of calling "knowledge" is knowledge in the strict sense of the term.

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CHAPTER X

POSTULATES OF DESCRIPTIVE SCIENCE

As we saw in the last section of the preceding chapter (see also pp. 124 f.), every science seeks to approximate as closely as it can to the mathematical model. In other words, the aim of the scientist is to explain the greatest possible number of facts by means of the smallest possible number of assumptions. This "law of parsimony," as it is called, is the fundamental principle of all scientific method. By an assumption, or "postulate," we mean principles which cannot themselves be proved, but which are needed in order to prove others.

The principles which can be proved or demonstrated are known as "theorems." Ideally, every science should be presented in the form of a body of doctrine which can be shown to follow with rigorous logical necessity from a relatively small number of postulates. Practically, of course, every empirical science includes certain "brute facts" for which there is as yet no explanation. The man of science, however, cannot remain satisfied with this state of affairs; but is always hoping and striving to find an explanation for all phenomena that are capable of experimental verification.

Now "to explain" is to incorporate into a logically integrated system of propositions. So far as possible our facts must be shown to follow deductively from already accepted principles; and these must be shown to follow from other accepted principles; and so on. It is obvious, however, that this process must end somewhere. Just as in geometry we come at last to the "axioms," so in every science we finally arrive at the postulates of that science, that is to say, at first principles which cannot themselves be proved.

In the paragraphs that follow we shall formulate and discuss certain postulates which are required, not only by some par-

ticular science, but by every science in so far as it purports to be a description of objective reality.

1. There Is Something extra Mentem, Something which Is Not Included within the Set of Propositions that We Call Descriptive Science, to which These Propositions Nevertheless Refer

As we saw in a previous chapter (Chap. VIII,) it is impossible to prove with absolute cogency that there is an external world. If anyone chooses to deny it, we can no more give a rational demonstration of its existence outside the mind than we can prove the existence of other selves or of our own selves in the past.

The existence of the external world must then be accepted —if it is accepted—simply as a postulate, and not as a theorem which can be proved. And anyone who is unwilling to grant this postulate must, of course, have full liberty to reject it. But if he chooses to reject it, he must be willing to accept the consequences of his rejection. Now one of these consequences is this, that there could be no descriptions. For a description presupposes the *existence of something which is to be described.* Indeed, unless there is something beyond itself to which a description refers, it is meaningless to say that it is true or that it is false.

In this respect there is an obvious difference between a set of propositions which we characterize as a description and a body of mathematical doctrine. We are sometimes asked how it is possible that two systems of geometry are both true, and yet differ in their postulates and in the theorems derived from them. To my mind, the correct answer is to say that geometry, as such, is neither true nor false but *valid,* or if there is some error of demonstration, *invalid.* Validity and invalidity, I should say, are properties of arguments or demonstrations; truth and falsity are properties of propositions. A syllogism, for example, or that which purports to be a syllogism, is either valid or invalid; the propositions which compose it are either true or

false. On the other hand, it is meaningless to ask whether an argument is *true,* and equally without meaning to ask whether a separate proposition is *valid.* A proposition which is presented as a *theorem* may, however, be true or false in its quality of being a proposition, and also valid or invalid in its quality of being the conclusion of a demonstration.

In other words, as long as we restrict our attention to the point of view of internal consistency, as long as we, so to speak, remain within the system, we have neither truth nor falsity, but only validity or invalidity. Only when we understand a proposition or set of propositions to refer to something beyond the system to which it belongs can we speak significantly of truth and error.[1]

This something beyond we shall speak of as "the real." While we have stressed the thought that *the real* is *extra mentem,* that is to say beyond or outside the mind, it must be understood, of course, that the *mind* is also a part of the real. This may be justified by pointing out that every mind is *extra mentem* with respect to other minds.

At this point we need not raise the question of the nature of the real. We need not ask now whether it is material or immaterial, spatial or non-spatial, temporal or super-temporal. Although we shall speak of it in the singular number, this is only for convenience; and we do not wish to prejudge the issue between singularism and pluralism. All that concerns us now is to insist that if there is to be a description, there must be something to describe; and that this something, which we have called the real, is not identical with or included within the set of propositions which constitute the description.

2. No Description of the Real Is True unless It Is Free from Contradiction

If a returned traveler should tell us that somewhere in the South Seas there is an island which has the shape of a circular

[1] This is not inconsistent with the coherence theory of the *test* of truth, but is rather an account of the *meaning* of truth. See p. 278.

parallelogram, we should never go to see whether his tale is true or false. We should at once reject the story as untrue and stigmatize the concept as inconceivable and therefore unreal. In the same way we should say that it is logically impossible that two and two should make five; or that the world should contain at the same time both irresistible forces and immovable bodies; or that there should be two mountains ten miles apart without any intervening valley; or that a person should live for forty-five years and be only thirty years of age. All of these, we should insist, would be logically impossible or inconceivable.

If any description of the real is internally contradictory, then, we at once pronounce it untrue. We have no logical right, however, to change this statement so as to read, "If any description is internally consistent it is therefore true." For example, there is no internal inconsistency in the conception of a mountain of pure gold; but no such mountain exists. As we saw in the previous chapter in discussing the coherence theory of the test of truth, a piece of clever fiction may be internally consistent; and we therefore have no means of telling fiction from truth until the set of propositions under consideration becomes sufficiently broad to reveal inconsistency. As long as we are dealing, then, with relatively small sets of propositions, it would be unsafe to regard *conceivability,* in the sense of freedom from contradiction, as a sufficient criterion of *existence.* All that we are suggesting in this section is the postulate that *inconceivability* is a sufficient criterion of *non-existence.*[2]

Now, this, too, is a risky assumption. And the skeptic is quite right in calling our attention to the risk. If someone cares to maintain that two contradictory propositions may both be true, that the real has mutually contradictory attributes, I know of no reasoning by which his contention can be refuted. All that

[2] The reader will observe that in this discussion the adjective "inconceivable" is not employed in the sense merely of unimaginable, or of unacceptable to the mind, but rather in the sense of *logically self-contradictory.* An inconceivable notion, accordingly, is one that consists of incompatible elements; that is, of elements which are logically inconsistent. (See p. 288.)

we could do would be to point out the intellectual inconvenience, to say the least, which his denial of our postulate would entail.

Are There "Antinomies" of Reason?—Kant's doctrine of the "antinomies" may seem to be at variance with our postulate. Thus this celebrated philosopher maintains [3] that in seeking to give an account of ultimate reality the human reason becomes entangled in certain inevitable contradictions. We can prove with equal cogency, he contends, that the world had a beginning in time, and that it did not have a beginning; that the world is limited with regard to space, and that it is not limited; that every compound substance consists of indivisible parts, and that nothing exists which cannot be further subdivided; etc.

We should not too hastily conclude, however, that our postulate is destroyed by Kant's reasoning. In the first place, not all competent thinkers are willing to admit that the alleged oppositions of reason with itself have been shown to exist. In the case of each antinomy, they maintain, the argument for the "thesis" or for the "antithesis" or for both is unsound. In the second place, it is important to note that Kant never professes to establish either the thesis or the antithesis by a direct demonstration; but that in every case he follows the method known technically as the *reductio ad absurdum.* That is to say, in each case he seeks to establish the thesis by showing that the antithesis is logically impossible; and then seeks to establish the antithesis by showing that the thesis is logically impossible. All that he has done, then, even if we assume the arguments to be sound, is to *dis*prove *both* thesis and antithesis. This suggests to us that thesis and antithesis, instead of being in the strict sense of the term *contradictories,* are rather *contraries,* both of which may be false.[4] There is nothing, therefore, in Kant's doctrine of the "antinomies" which runs counter to our postu-

[3] *Critique of Pure Reason* (Max Mueller's translation), 1911, pp. 339 ff.

[4] For the difference between contraries and contradictories, see any good work on logic.

late that no set of mutually incompatible propositions can constitute a true description of reality.

Are There "Truths above Reason"?—Are there not, however, truths which are beyond human comprehension, and which therefore appear to the mind of man to be inconceivable, although in reality they are not? Thus it has been admitted by some of the theologians that certain doctrines taught by the Church on the authority of divine revelation are rightly called "mysteries"; for, although known to be true, they appear to us to be composed of incompatible elements. Thus Cardinal Newman is at pains to make clear that it is possible for us to give assent to a mystery. "A mystery," he says, "is a proposition conveying incompatible notions, or is a statement of the inconceivable. Now we can assent to propositions (and a mystery is a proposition), provided we can apprehend them; therefore we can assent to a mystery, for, unless we in some sense apprehend it, we should not recognize it to be a mystery, that is, a statement uniting incompatible notions. The same act, then, which enables us to discern that the words of the proposition express a mystery, capacitates us for assenting to it." [5] Instead of accepting our postulate that inconceivability is an index of non-existence, Newman maintains that the inconceivable may nevertheless be real. "An alleged fact," he continues, "is not therefore impossible because it is inconceivable; for the incompatible notions, in which consists its inconceivableness, need not each of them really belong to it in that fulness which should involve their being incompatible with each other." [6]

Somewhat similar is the position of Mansel. "It is our duty," he says,[7] "to think of God as personal; and it is our duty to think that He is infinite. It is true that we cannot reconcile these representations with each other; as our conception of personality involves attributes apparently contradictory to the notion of infinity. But it does not follow that this contradiction exists anywhere but in our own minds: it does not follow that

[5] *Grammar of Assent*, 1870, p. 45. [6] *Ibid*, p. 51.
[7] *Limits of Religious Thought*, 1866, p. 106.

it implies any impossibility in the absolute nature of God. The apparent contradiction . . . is the necessary consequence of an attempt on the part of the human thinker to transcend the boundaries of his own consciousness. It proves that there are limits to man's power of thought; and it proves no more."

Now, as we have previously remarked, anyone who wishes to reject our postulate that *no description of the real is true unless it is free from contradiction,* has the right to do so. It seems to us, however, that such a denial makes it impossible to discriminate between true and false descriptions. For if a true description may consist of mutually contradictory propositions (or, what amounts to the same thing, a true proposition consist of incompatible notions) there is no way of telling which descriptions (or propositions) are true and which are false. Newman and Mansel, to be sure, do not feel this difficulty as keenly as we do; for they believe that they have an infallible authority—the authority of the Church or of the Bible—upon which they can rely for the determination of all really important issues. Even they, however, when they come to deal with questions concerning which their infallible authority has made no definitive pronouncement, must needs make use of the test of non-contradiction; and those of us who recognize no infallible authority have no other test of truth except that of non-contradiction, or of "coherence," as we called it in the previous chapter.

It should be added that nothing is gained by making the distinction suggested by Mansel between a contradiction that is only apparent, and one that is, shall we say, genuine. For while we must admit the possibility that what appears contradictory to the human mind might be wholly free from contradiction as viewed by some superhuman intelligence, we must insist nevertheless that our thinking must be done by human minds; and therefore the only incompatibility upon which we can depend as an indication of the falsity or unreality of alleged descriptions is incompatibility *as it appears to us.*

3. There May Be Genuine Knowledge which Is Knowledge of Only a Part of the Real

To insist that we may have genuine knowledge which is not knowledge of everything will probably be, for most readers, a case of "carrying coals to Newcastle"; for to common sense this postulate will probably seem self-evident. As we have remarked before, however, philosophers usually insist, for better or for worse, upon going beyond mere common sense; and those especially of an idealistic or singularistic turn of mind have commonly maintained, either explicitly or by implication, that knowledge of the whole of reality would somehow be truer or more genuine than knowledge which is limited to a part. Strangely enough, even the pragmatists, who in many respects are at the opposite pole from the idealists and singularists, frequently employ language which suggests the same view. And it must be admitted that the coherence theory of truth (see Chap. IX, pp. 277 ff.), unless properly safeguarded, suggests this position. For if our only test of truth is the compatibility of the idea or proposition in question with the system of previously recognized truths, it seems to follow that the wider the system with which the given idea or proposition coheres, the truer or the more nearly true it must be; or even that we do not arrive at truth, in the strict sense, until there is coherence with the entire system of truths.

Does the Human Mind Possess Genuine Knowledge?—The chief difficulty with the theory that there is no genuine knowledge which is not knowledge of the whole of reality appears to me to follow from the fact that the human mind is finite. It never knows *all* of the real, but only larger or smaller parts. Only on the assumption, then, that knowledge of a part is genuine knowledge can we finite knowers hope to have true descriptions. If to know the "little flower" of Tennyson's verse it is necessary that I know "what God and man is," then it is clear that I do not have genuine knowledge even of the flower. We must attack our problems by a piecemeal procedure.

Analysis must be assumed to be valid as a scientific method. Human knowledge advances, and can only advance, by division of and abstraction from the real. Accordingly, unless we assume that knowledge of a *part* may be genuine, we can never hope to arrive at a knowledge of the whole.

Are There Degrees of Truth?—But are there not "degrees of truth?" Is not an idea which has been shown to be compatible with an extensive system of ideas "truer" than one which has not been so completely verified? Phraseology of this kind is, I believe, a consequence of the confusion previously noted between the question of the *meaning* of truth and the question of the *test* of truth. (See p. 278.) For many examples might be adduced of propositions which obviously relate to very small parts of the real, and yet are as true as any proposition—even if uttered by an omniscient intelligence—could possibly be. Thus, if I say, "In this room there are four chairs"; or "The watch which lies on my table weighs less than five pounds"; in either case the proposition is absolutely true, although in formulating it I am thinking of a very small part of the universe. And neither of these truths becomes any truer or attains any higher degree of truthhood if we assume it to be taken up and verified by some omniscient knower who would be able to envisage the chairs or the watch in relation to everything in the heavens above, the earth beneath, and the waters under the earth.

In short, wider coherence affords added evidence of truth, or perchance reveals falsity; but *it does not alter the nature of truth.* A proposition is either true or else it is false; although the human mind, it must always be conceded, may be in error concerning it. In other words, while there are *degrees of probability,* there are not degrees of truth.

Is There Partial Truth?—If, then, we do not recognize degrees of truth, there are only two senses in which we can permit the use of the phrase "partial truth"—if we permit it at all. (1) To say that an idea or a description is partly true may mean that it is complex; and that some of its component

notions or propositions are true while others are false. (2) To say that an idea or a description is partly true may mean that it is only an approximation to the truth. Thus, to say that it is half-past three, when it is in fact only twenty-nine minutes and thirty-five seconds after three, would be only approximately correct. In either case, by a change of phraseology, the description of reality might be made true without qualification. In the first case, this would have to be accomplished by dividing the description into its elements and affirming or denying each separately. In the second case, a statement of absolute truth could be attained by adopting a phraseology which, while less precise in form, would be absolutely precise in fact. To return to our example, instead of saying that it is half-past three, one might say that it is later than three o'clock.

Do Propositions Become True?—We cannot accept the view that ideas and propositions "become true." There is, to be sure, an obvious sense in which a statement which was not true at the time of utterance subsequently becomes true. For example, if I should say of a ten-year-old boy, "This boy is twelve years old," it would no doubt be a matter of only two years until my statement would be true. This, however, is not what William James and the pragmatists seem to mean when they speak of ideas as "becoming true." They have reference, instead, to the process of verification as a result of which the idea or proposition comes to be recognized as true because it is found to cohere with a wider and ever wider range of experience. This, however, it seems to me, is also a view which arises out of the failure to distinguish between the meaning of truth and the process by which truth, thus defined, is tested. To say that an idea or a proposition is true means, I should say, that, however far we shall subsequently extend the range of our experience, the idea or proposition in question will never be found to be incompatible with experience which we continue to regard as veridical. Our *test* of truth is the discovery that so far as our experience has already gone, no such incompatibility has been discovered. In short, when we speak of *co-*

herence as the test of truth, we are thinking of agreement with *past* experience; while when we speak of *correspondence* as the meaning or definition of truth, we are thinking of *future*[8] (or of *virtual*) experience. The greater the amount of coherence, the greater the probability that the idea is true; but the truth itself is an affair of an agreement with experience which has not as yet been discovered. In other words, agreement of our idea with past experience is an index (not always infallible, of course) of agreement with future experience.

The Externality of Relations.—Finally, the postulate which we are discussing in this section involves the assumption that some relations, at least, are "external." (See Chap. VIII, p. 255.) For if relations are "internal," if they enter into the very constitution of the terms which are related, then in order to know one small part of reality I should have to know the relations of this small part to all the rest; in other words, I could not know anything without knowing everything. The theory that analysis is impossible, that nothing can be genuinely known in isolation, is a consequence of the theory of the internality of relations; and this theory is far from self-evident.

We may then retain our postulate that, in some cases at least, knowledge of a part is genuine knowledge. Like all postulates, however, this one too is incapable of proof; and if anyone cares to maintain that only knowledge of the Whole is knowledge in the strict sense of the term, and that genuine knowledge is accordingly a possession of the Absolute alone, I see no way to refute his contention. If this point of view were adopted, however, we should be in need of some convenient term to use in designating the so-called knowledge possessed by the finite mind, which, after all, is the only kind of cognitive experience that science and philosophy can hope to attain. And we may venture to suggest that it would be more convenient to retain the name "knowledge" for the cognitive experience of

[8] Of course, when the test has been completed, this future experience has become past experience.

finite minds, and to find some other name for that which is said to be enjoyed by the Absolute alone.

4. Our Cognitive Processes—Sense-Perception, Memory, Reason—Give Us Knowledge of the Real

The skeptic is impressed by the "illusions" of sense-perception. The rails of the railroad track seem to converge in the distance, the stick seems to be bent at the surface of the water, etc., etc., through the whole dreary catalogue of illusions of the senses. The skeptic suggests that inasmuch as the senses have been found to be deceivers in so many cases, they cannot be trusted to report truthfully in any case. Our reply to the skeptic may be expressed in the form of a paradox: *in order to convict the senses of error, we must assume them to be veracious*. For how do we know that the rails do not really converge? Only because, if we walk along the track to the place where we saw them coming together, they will be *seen* to be as far apart there as anywhere else. And how do we know that the stick is not really bent? Only because, if we run our hand along it, the stick feels straight; and if we pull it out of the water (or plunge it completely under), it looks straight. In short, consider any case which you choose of alleged error in sense-perception, and you will find that the fact of error can be established in no other way than by comparison with other results of sense-perception; and these other results must therefore be assumed to be veridical.

"This sort of reasoning does not, of course, prove that sense-perception is *always* trustworthy. Neither does it prove that we *ever* have veridical perceptions. All that it proves is that our right to postulate the general trustworthiness of our senses cannot be successfully assailed; for it is only by means of the senses that such errors as arise in sense-perception can be detected." [9]

Much the same are the considerations which must be urged in reply to the skeptic's attack upon the reliability of memory.

[9] Dotterer, R. H., *Beginners' Logic*, 1924, p. 304.

Only by memory can memory be proved false. My memory, let us say, has misled me in regard to some event of the recent or the more remote past. This can only mean that my recollection of the affair is inconsistent with that of other persons, or with other facts which I myself remember, or, it may be, with written records.

The last case, the correction of memory by reference to written records, may seem at first sight to introduce a different principle. But here too the correction of memory presupposes the veracity of memory. My present recollection is found to be erroneous, let us say, by reference to my diary. But that the diary is really mine; that I actually wrote what is written therein; that the characters employed in the writing were understood by me at the time of writing in the same way in which I now interpret them—all these and other necessary links in the chain of reasoning must be accepted on the authority of memory.

We have seen that errors of perceiving cannot be detected without the aid of sense-perception, and that errors of remembering cannot be detected without the aid of memory. On the other hand, errors of *reasoning* may frequently be detected by reference to the facts of experience, if we assume these latter to be veridical. Sometimes, however, the test in the case of reason too may be homeopathic; the faults of reason may be self-cured. For example, an error may be found in a geometrical demonstration. On the assumption that reason is for the most part to be trusted, we show that in this particular case reason has erred. Thus it is manifest that the case of reason does not differ essentially from that of memory and sense-perception.

In short, any argument by which the skeptic might seek to demonstrate the untrustworthiness of our cognitive processes rests upon the postulate that they are trustworthy. We need not assume, however, that sense-perception, memory, and reason are infallible. We recognize that errors frequently occur. We postulate, not the universal, but the general reliability of our intellectual "faculties." The burden of proof rests upon him who

asserts that error has occurred. Every cognitive act is assumed to be veridical until it is proved erroneous.

A distinction should perhaps be made between each one's attitude toward his own cognitive experiences and his attitude toward the reported experiences of another knower. Thus the courts attach much more importance to what the witness knows "of his own knowledge" than to what he testifies that he learned from someone else. First-hand reports are more highly esteemed than second-hand or third-hand reports; and one's own immediate experience is usually considered best of all. Nevertheless, the same general principle applies to the cognitive experiences of others as to our own. For the most part we assume, until the contrary is at least suggested, that other men are honest in reporting their findings; and also, until we have some positive ground for suspecting the contrary, that they are competent. For only upon this assumption would the coöperative work of the sciences be possible. In postulating that our cognitive processes give us knowledge of the real, the pronoun "our" should then be understood to refer to others as well as to ourselves.[10]

5. The Special Sciences Are, or at Least Include, True Descriptions of the Real

On account of admitted errors of sense-perception it has been suggested, as we have seen, that sense-perception can not be trusted to give us true descriptions. In the same way, the admission that theories and points of view which were at one time regarded as established in various fields of scientific investigation have now been superseded by radically different theories and points of view, has been regarded by some critics of science as equivalent to the admission that science does not give us descriptions of reality, but that its account of things is merely "symbolic" and "fictive."

[10] See the author's *Beginners' Logic*, in particular the chapter on "The Presuppositions of Science," where much the same ground is traversed as in the present section.

It is obvious, however, that this conclusion is no sounder in the case of science than in the case, already discussed, of everyday observation. For in the first place no one contends that science is an infallible account of the real. The possibility of error must always be conceded. And in the second place, it is only by the subsequent advance of science that "established" theories are shown to be untenable. *The proof that science has erred is dependent upon the assumption that for the most part the results of scientific investigation are to be accepted.* In short, while it may be logically possible to attack particular conclusions of contemporary science—such, for example, as the theory of evolution, or the wave theory of sound, or the electronic theory of the atom—it is no more possible to deny the veridical character of science-in-general than it is to maintain the corresponding denial in the case of sense-perception or memory.

Indeed, what we call *science* is simply everyday cognitive experience made more extensive and systematic; more thoroughgoing, methodical, and painstaking. If then, while including the descriptions arrived at by common sense within the class of genuine descriptions of reality, we should deny this status to the results attained by scientific research, our attitude toward science would seem to imply the principle that *the more pains we take* in trying to discover the nature and structure of the actual world, *the less likely we are to succeed* in the attempt. This may, of course, be the case; but I can see no reason for affirming that it is the case, or for denying that the contrary principle is true. Children do indeed tell us that you never find money in the street when you are looking for it, and that if you wish to find money you must *not try* to find it. But whether or not this is true of the finding of money, it seems unlikely that it should be true of the finding of truth. For can we really believe that a hasty glance at the sky will teach us as much as we could learn by looking through a telescope, that guesswork is superior to accurate measurements, or that the vague ideas of common sense or "intuition" are more likely to be descrip-

tive of reality than the results attained by the painstaking, methodical procedures of the sciences?

Furthermore, if it be suggested that we should accept the results of common-sense observation while remaining distrustful of "science," I should have considerable difficulty in finding the line of division between them. For example, would a plan of the streets and subways of New York belong to the field of common-sense observation or to that of science? And if we should decide to regard the science of geography, with its plans and maps, as for the most part worthy of our confidence, what should we say of astronomy or physics or biology?

It must be admitted, however, that many so-called "natural laws" are abstract and hypothetical rather than literally descriptive. There is a sense in which many, at least, of the concepts and generalizations of the sciences may fairly be said to be *inventions* rather than *discoveries*. This may be admitted, I think, without weakening the position which we are defending; for inventions are successful only when they work, and they do not work unless they conform to reality.

We may then admit, as indeed we have already recognized in our account of the achievements of physics (Chap. IV, p. 82), that many of the laws of nature as formulated by the sciences are of a purely ideal character. They are hypothetical statements of what would take place in some never-existent situation, rather than descriptions of what does take place in any actual process. For example, it is doubtful whether any material body ever behaved in the manner described by Newton's first law of motion. Material bodies seldom or never move in straight lines or with uniform velocities. We may say, to be sure, that they *would* move in this fashion *if* they were not acted upon by external forces. The condition specified by the law is thus a condition which is usually, and perhaps always, contrary to fact. In the interest of generality it is convenient to abstract from some of the elements of the situations to which the law is meant to apply. This law is not, then, a description of reality; it may rightly be called a "highly selective construct," or even

an "invention." [11] Considered by itself, in isolation from all other laws of nature, it might even be said to be a falsification of reality. It is a falsification in the sense that it neglects certain elements of every actual situation. But *if this law is supplemented by other laws* which take care of these neglected elements, the entire body of laws thus formed is not a falsification, but a more or less accurate description of reality.

The precise way in which science slices up, as it were, the various situations which it seeks to describe may be a matter of convention rather than of rational necessity. Thus, in describing the motions of material particles, certain elements of the situation are taken care of, so to speak, by the law of inertia; other elements by the law of gravitation; other elements by the laws of electromagnetic attraction and repulsion; still other elements, it may be, by still other laws. The laws might perhaps have been stated differently; and if they had been stated differently, there would no doubt have been a somewhat different division of labor among them.

A geographer in writing an account of any given country might arrange his subject-matter in any one of a dozen different ways; and whichever of these possible arrangements is decided upon, any particular subdivision of his account, if it stood alone, would be in a sense untrue because abstract and incomplete; yet the entire account may be a true description of the country in question.

In the same way, while invention and convention have doubtless played their part in determining the formulation of scientific laws, any considerable group of these laws may reasonably be supposed to correspond more or less accurately to processes taking place in the actual world. To argue that because each of the laws of a given group is not a description of reality, all of them taken together are not a description of reality, would be a clear case of what logicians have called the "fallacy of composition." [12]

[11] Cf. Otto, M. C., *Things and Ideals*, 1924, p. 214.

[12] See, for example, Creighton, J. E., *An Introductory Logic*, 4th ed., pp. 174 ff.

This point might, indeed, have been discussed in the third section of the present chapter when we considered the postulate that there may be genuine knowledge which is knowledge of only a part of the real. We did not mean to suggest in that section that knowledge of a part is always genuine knowledge, or that what is genuine knowledge for a given purpose need be genuine knowledge for all purposes. There is an ever-present possibility that analysis and abstraction, indispensable as they are as logical procedures for the discovery of truth, may lead to a falsification of the real. If knowledge of a part is mistaken for knowledge of the whole, then of course partial knowledge becomes at least partial falsification.

If the phrase is understood in the way in which it was defined in a previous section (pp. 291 f.), it may be freely admitted that the sciences are only "partly true." For, as already remarked, no one claims that the sciences are infallible bodies of doctrine. While it is very improbable that any given proposition found in our contemporary textbooks and manuals of science is false, it is highly probable that *some* of them are false. The question is very similar to that of the probability of being struck by lightning. While it is extremely improbable that you or I or any given individual will meet this fate, it is very probable indeed that someone, somewhere in this broad land of ours, will be struck by lightning.

Furthermore, we may admit that many of the laws of nature formulated by the sciences are only "partly true" in the sense that they are merely approximations to the truth. (See p. 292.) They would then bear the same relation to the exact truth as the number 3.1416, or 3.14159, bears to the value of π; or as the number 1.414213 bears to the square root of 2. A relation of this sort is manifest in the case of the values given for the velocity of light, the atomic weights, etc., etc. And if Einstein is right, it is in this way that we ought to think of Newton's law of gravitation. (See p. 77.)

Our present postulate might have been included as a special case under Number 4; for the postulation of the trustworthi-

ness of human reason would obviously carry with it that of the veridical character of science, the creation of reason. Inasmuch, however, as the case of science includes some features which differ at least superficially from those of what I have called common-sense observation, it seemed advisable to treat it separately. In so far as our present postulate differs from that of the general trustworthiness of our cognitive processes, we may say that it is the postulate—which, of course, is incapable of strict proof—that *it pays to take pains* in the quest of truth.

6. The Parts of the Real Are So Inter-related that It Is Usually Safe to Assume (a) that Resemblance Is an Index of Further Resemblance; (b) that What Has Been Will Be; and (c) that Any Given Event Has a Cause

Each of these three subordinate propositions may, if it is preferred, be considered as itself a postulate. In discussing them we shall be compelled more definitely than in the case of the previous postulates to face the question of the relation of epistemology to metaphysics. In particular, we shall have to raise the question whether, and to what extent, necessities of our *thinking* may become grounds for affirming principles of *being*.

(a) *If any two objects have been found to be similar in certain respects,* it is probable that upon further investigation *they will be found to be similar in other respects.* By some writers this has been called the *postulate of kinds,* for the reason that the practical value of classification is dependent upon it. It is of course logically permissible to assemble individual objects into classes on the basis of any common quality upon which we happen or choose to fix our attention. The classes which are of chief importance in explanation and description, as well as in everyday living, are those, however, which are known as "natural classes." For such classes have been assembled on the basis of resemblances which have been found to be indices of further resemblance.

The principle may be represented symbolically as follows:

Let M and N be any two objects whatsoever, and suppose that they have been found to resemble each other in the possession of the common qualities *a, b, c,* etc. Suppose, further, that M is found to have the additional quality *x*. Then the postulate now under discussion would assert the probability that the quality *x* will be found in N also.

Now and then, to be sure, we are disappointed in our expectation that things which resemble each other in certain respects will be found to resemble each other in additional respects. In such cases we say that the analogy "breaks down" or is "false." More frequently, however, the expectation is fulfilled. Or it may be that we have learned by experience which resemblances to consider important and which to disregard. At any rate, the experience of the race has brought about a grouping of many of the individual objects of our world, such that we are usually able to predict their nature and behavior. Thus we classify things as horses, cows, cats, and dogs; as oak trees, rose bushes, potato vines, and poison ivy; as limestone, iron ore, water, salt; etc., etc. And when we come across anything for the first time, on the basis of certain qualities which we observe it to possess, we place it in a certain class; and we reason that because it is like the other things which belong to this class in respect to the qualities already discovered, it will be found to be like them in other qualities as well.

For example, you say that yonder man whom we see walking down the street has a brain and heart and lungs. Yet you have never seen his brain or his heart or his lungs. How, then, do you know that he has these organs? Only by an inference based upon the postulate which we are now discussing. You know that certain bodies have been dissected and have been found to contain the organs in question. You perceive too that the man about whom we are speaking resembles these other bodies in certain respects which we have come to regard as important. And we reason that because he resembles them in these respects he would be found, if his body were dissected, to resemble them in additional respects.

This postulate, that resemblance is a fairly trustworthy index of further resemblance, *considered as hypothesis,* is justified then by the fact that it works. But there is no *a priori* reason why it should work. All that we can say is that in our world resemblances appear to go, for the most part, in flocks. But why they go in flocks, no one can tell. In description and classification we simply adopt the postulate that they do.

(b) A postulate, or subpostulate, which is closely related to the one which we have just been discussing, is *the principle of permanence,* as it may be called. Descriptive and explanatory science rests upon the assumption that *what has been will be.* We take it for granted that the laws of nature which are true to-day will remain true to-morrow and next week; that classifications which have been found serviceable will continue for the most part unaltered; that the properties of most objects will remain approximately the same. Here again it is obvious that we have no rational ground for our confidence. How do we know that a substance, such for example as iron or copper, will not change its valence, melting point, specific heat, etc., over night? Of course we do not *know.* We simply take it for granted.

The permanence which we postulate is, to be sure, not *absolute.* It is obvious that many things are in constant flux, and that many other things remain only approximately as they were. All that we postulate is the proposition that *for the most part* the real is not subject to changes which are rapid or abrupt; and that where changes occur in the real it is usually possible to discover laws or uniformities in accordance with which these changes take place.

(c) This leads us at once to *the postulate of determinism,* which is the third of the principles which I have included under the head of the postulate of the inter-relatedness of the parts of the real. This is the assumption that such changes as take place in our world are so related that one of them may be regarded as a sign or *cause* of another; or, perhaps better, that antecedent differences are indices of subsequent differences.

The common statement that every effect has a cause, is, of course, self-evident; for it is tautologous. Certainly every effect has a cause; for to have a cause is included within the very definition of the word "effect." On the other hand, the statement that every *change* or every *event* has a cause is far from self-evident. There is, indeed, if we care to question it, no way in which it can be rationally established.

Whether thoroughgoing determinism or partial indeterminism is the true view of the world, we are not now concerned to inquire. (For a further discussion of this topic, see Chap. XII, pp. 346 ff.) There is no *a priori* reason for refusing to admit the possibility that some events are uncaused. Our present point, however, is merely this, that a descriptive science of the real is possible only so far as determinism is the true hypothesis. There may, indeed, be undetermined events; but if they occur, they fall beyond the scope of science. Just as we did not postulate the absolute inerrancy of our cognitive processes, but only their general trustworthiness, so it is not necessary to believe in thoroughgoing determinism, but only to postulate that for the most part the cause-effect relation holds.

We do not find, then, that our epistemology implies any definitive metaphysics; unless, indeed, from postulate Number 3—that there may be genuine knowledge which is knowledge of only a part of the real—we should infer the necessity of a pluralistic view of the world. It is sometimes said, to be sure, that science must postulate the *unity of the universe*. It would be strange, however, if a mere necessity of methodology should be revelatory of the fundamental structure of reality. And it is clear as a result of our discussion in the last few paragraphs that our threefold postulate of the inter-relatedness of the real, including as it does the principle of kinds, of permanence, and of determinism, need not commit us to a monistic or singularistic view of the cosmos. The most that it can require of us is the assumption that there is, and probably always will be, more interrelatedness among the parts of the real than has at any given time been discovered.

Postulates as Hypotheses.—It may, however, occur to someone to inquire why, when we are making postulates, we cannot make any that we have a mind to. Why cannot the singularist, then, simply *postulate* the complete unity of the cosmos —if he likes to think of it in that way?

The question grows out of a natural misunderstanding. If, as we have admitted, the sciences are founded upon principles which are incapable of demonstration, and which are therefore simply taken for granted as postulates, should we not then be allowed to postulate all such principles as we feel the need of in theology or ethics or political theory, as well as in the natural sciences? We must insist, however, that our right to postulate principles that cannot be proved must not be made a cover for making any and every sort of assumption whatsoever. We do not claim the right to postulate anything and everything which we wish to believe or which it pleases our fancy to maintain; but merely such first principles as are required if science is to be possible. In the postulation of first principles we are not permitted to indulge our caprice; for it is one of the fundamental principles of methodology—a postulate itself, but one that is indispensable if science is to be preserved from superstition—that *unproved first principles are not to be multiplied beyond necessity*. According to this principle, which is known as the "law of parsimony," we are under obligation to prove the greatest possible number of theorems with the smallest possible number of postulates. (See pp. 124 f.) Accordingly, while we have no right to ask that a postulate be proved, there is still a sense in which its place in the system must be rationally justified. And its only possible justification is its *fertility* and *indispensability*. In other words, it must bring forth theorems which are in harmony with the rest of our knowledge; and it must be required in order to provide the simplest possible foundation for the sciences.

The Refutation of the Skeptic.—It has been our purpose in this chapter to propose a defense of science and philosophy against those who are known traditionally as "the skeptics." To

some readers our "defense" may have sounded suspiciously like a surrender to the attackers. We have not intended, however, to make a traitorous surrender. The method of defense which we have suggested has been to agree with the skeptic, to accept his principal contention, and to raise the question, "What then?"

We agree with the skeptic that there is a sense in which all of our fundamental principles are doubtful. It does not follow, however, that science is therefore impossible, worthless, or untrue. All that follows is that the sciences must be recognized as depending upon the method of postulation. It is in mathematics that this method has become most clearly self-conscious. *That all axioms are postulates* is a proposition which has by this time, I suppose, won well-nigh universal acceptance. In mathematics we are not disturbed if the skeptic demands that we prove the axioms. We simply agree with him that they cannot be proved, and challenge him to make the most of it. No one is obliged to accept the axioms, if he is willing to pay the price of non-acceptance; but without axioms there can be no mathematics. Exactly the same is the status of the postulates of descriptive science. No one is obliged to accept them; but without postulates there can be no description.

And there is a further misunderstanding against which we must be ready to protest. To say, in agreement with the skeptic, that all of our fundamental principles are doubtful does not mean that they, as a matter of fact, are *doubted* by any sane mind, or that they ought to be doubted. It may be that some of our postulates have never been successfully doubted by anyone. Some, I believe, are much harder to doubt than others. What we mean, then, when we say that the axioms of geometry and the first principles of all the sciences are postulates is, not that we entertain a feeling of doubt concerning them, still less that we believe any of them to be false or contrary to fact; but merely that we recognize them to be *unproved,* and *probably unprovable.*

The Indefinables as Postulates.—Just as one might attempt to make a catalogue of all the propositions which descrip-

tive science employs without proof in order to prove other propositions, so one might also attempt to make a list of all the concepts which cannot be analyzed into, or explained in terms of, simpler or more primitive concepts.

It may be that some of my readers will be able to define terms like line, point, space, time, energy, matter, motion, life, mind, etc., or some of them; but in any case the process of defining will have to come to an end somewhere. We are thus confronted with a number of concepts which we recognize as "indefinables." For example, we might perhaps define a *line* as a path of a moving point; or we might define a *point* as the intersection of two lines. In the former case, *line* would be defined and *point* would be the indefinable; while in the latter case, *point* would be defined and *line* would be the indefinable.

Accordingly a complete catalogue of the postulates of description—that is to say, of the *unprovables*—ought to be accompanied by a list of the *indefinables* as well; for description presupposes a common understanding of the terms which are employed, and especially of such terms as are employed without definition. It is obvious, too, that just as an ideally perfect science would derive the greatest possible number of theorems from the smallest possible number of postulates, so it would also define the greatest possible number of concepts by reference to the smallest possible number of indefinables.

It might then be convenient to extend the meaning of the term "postulate" so as to include the indefinables. Or, if we are unwilling to do this, we may say that it is necessary, in the interest of descriptive science, to postulate that for the most part we all use the terms of discourse in the same sense. This of course is a hazardous assumption; and in many particular cases it is found to be contrary to fact.

Coöperative Philosophizing and the Statement of Postulates.—In this chapter we have made no attempt to formulate the postulates of evaluation; but have limited ourselves to what may be called in the broad sense the field of description. (For an account of some of the postulates of evaluation, see

Chap. XIII.) It is unlikely, indeed, that anyone will ever succeed in making a complete list of the unproved principles and the undefined terms of which he himself makes use, either explicitly or by implication. The cause of clear thinking would be served, however, if everyone who presumes to philosophize could be induced to state clearly whether the propositions which he advances are to be understood as postulates or as theorems. For it is idle to discuss the validity of the theorems until there is at least a tentative agreement concerning the postulates. While, if the postulates have been clearly stated, discussion may profitably take either of two directions. In the first place, assuming for the sake of the argument that the postulates may be accepted as stated, we may raise the question whether the theorems which have been derived from them really follow. And in the second place, we may ask whether any postulates have been omitted which ought to have been included; and whether the postulates as stated are really independent of each other, or whether some of them might have been included among the theorems.

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CHAPTER XI

THE PROBLEM OF BEING

Having postulated that human knowledge is a description of "the real," and not merely a projection of the mental peculiarities of the knower, we are now ready to plunge into that jungle of philosophical speculation and discussion which is known as "metaphysics." If the real is knowable, it is pertinent to inquire concerning its ultimate *nature* or "substance"; and also concerning its *structure* or type of organization. As we learned in our introductory chapter (p. 15), the discussion of the nature of being or of the real is known as the ontological inquiry, while the discussion of its structure is known as the cosmological inquiry. The former will occupy our attention in the present chapter; while consideration of the latter group of problems will be deferred so far as possible—for it is impossible to keep the two inquiries entirely separate—until Chap. XII.

Various answers have been suggested to the ontological question. Some philosophers have said that the ultimate "stuff" or substance of all things is *mind;* others have held that it is matter. The former have been known as "mentalists," "spiritualists," or "idealists"; the latter as "materialists." Most of these terms are likely to be misleading. In particular, spiritualism, as the term is used in ontological discussion, must not be confused with the belief in communication with the departed by the aid of "mediums"; while both "idealism" and "materialism" should not be allowed to suggest connotations which properly belong to the field of ethics and have no rightful place in ontology. Both materialism and idealism are forms of *monism;* for they seek to understand the world of so-called mind and so-called matter in terms of but one of these as the fundamental reality. Thus

idealism holds that so-called matter is but a manifestation of mind or spirit; while materialism holds that so-called mind is but a manifestation of matter. The former holds that all phenomena without exception may be explained in terms of minds and ideas belonging to minds; the latter, that all phenomena without exception may be explained in terms of matter and the motions of matter. These and certain other forms of *monism* will be considered in the second part of this chapter.

1. Dualistic Theories

Opposed to both idealism and materialism, which attempt to understand the world in terms of but one fundamental kind of reality—though they quarrel as to which is the one—is *dualism,* which maintains that it is impossible to account for all phenomena in terms of but one kind of reality, but that it is necessary to recognize two. We shall present the dualistic position first, because in modern thought, at least, it is the older, and as the view of common sense is the foil against which the monistic theories are usually presented.

Varieties of Dualism.—It is important to bear in mind that there are various types of dualistic theory. These differ from each other and from subjective idealism by virtue, if we may so speak, of a difference in *degree of sophistication.*

(a) To a person who is wholly unspoiled by a knowledge of philosophy and psychology, it probably appears to be an obvious fact that mind is one thing and matter quite another. This is the view usually attributed by philosophers to the so-called "plain man," or "man in the street," as this hypothetical individual is frequently referred to in the jargon of philosophical controversy and discussion. It is sometimes said also to be the view of common sense. "Common sense or Naïve Dualism holds," says Professor Leighton, "that body or matter is just what we perceive to exist in the external world, by means of our senses. Likewise Mind is just what we are conscious of being when we feel and think and will." [1]

[1] Leighton, J. A., *The Field of Philosophy,* 1923, Chap. XV.

(b) It is not likely, however, that anyone ever to himself hath said, "I am a naïve dualist." Naïve dualism may be best thought of, indeed, as a "man of straw" set up only to be knocked down again in the game of philosophical discussion. It is in fact the theory of the mind-body relation which is imputed to those who in reality have no theory at all. For only a very little attention to the psychology of perception is required to suggest a doubt whether matter, at least, is so simple as the completely uncritical person would suppose. The first level of sophistication is represented historically by the dualism of Descartes and Locke. According to these philosophers, matter and mind are indeed two distinct and irreducible kinds of substance. Matter, however, as viewed by them, is not what it seems to be. To be sure, some of the qualities which we perceive in material bodies are really properties of matter; but other perceived qualities are properties of our ideas or of our ways of perceiving rather than of the material objects themselves.

(c) Just as this *Cartesian dualism* is more sophisticated than *naïve dualism,* so the position of Kant may be thought of as representing a second level of sophistication. According to Kant, what we call matter must be admitted to exist; things-in-themselves are independent of the mind which perceives them. Yet these things-in-themselves are unknowable, and cannot be said to have any of the properties which common sense is wont to ascribe to material bodies.

Dualism and Realism.—It is obvious that a dualist in metaphysics must, if he is consistent, be a *realist* in epistemology. The converse relationship does not obtain, however; for a person might hold without inconsistency that the object of perception exists outside the mind of the percipient, and nevertheless maintain that all things are themselves mental. Inasmuch as dualism thus implies realism, the reader will not have been surprised to find in our brief account of the three historic types of dualism a close correspondence with the types of realism discussed in a previous chapter. (Chap. VIII, p. 257.) The naïve dualist is also a naïve realist; he recognizes no distinc-

tion between primary and secondary qualities, but uncritically regards them as all alike objective. The Cartesian or Lockean type of dualism and realism recognizes and insists upon the distinction between the two kinds of qualities, and regards the primary qualities alone as objective. The Kantian type of dualism and realism refuses to make the distinction, and regards all qualities as subjective. We might add that, while chronologically Berkeley is earlier than Kant, from the standpoint of the logical relation of metaphysical and epistemological theories his view would come *after* that of Kant, as representing a still higher level of sophistication. Though Berkeley's view is no longer a dualism or realism at all, it may nevertheless be helpful to think of it as the final outcome—or, we might say in the light of our previous discussion, as the condemnation—of the movement of thought introduced by Descartes. Thus *naïve dualism, Cartesian dualism, Kantian dualism, and subjective idealism* would represent, not rigorously distinguishable points of view, but merely increasing degrees of sophistication.

The Cartesian Contrast of Mind and Matter.—Of the four points of view just referred to, the last named will meet us again when we discuss the various forms of monism. And of the three dualisms, we recognize that the Kantian variety is only formally dualistic and need not be discussed here; for it is hard to make sense of the idea of matter or body as existing, but as having neither extension, duration, nor motion. Inasmuch as naïve dualism is by definition a position which could not survive discussion, the only dualistic position which can be seriously defended is that of Descartes and Locke. At any rate, it is *Cartesian dualism* or some modification of it which is usually intended when writers on philosophy speak without any qualifying adjective of "dualism."

Descartes and his followers regarded mind and matter as *substances* which are entirely different from each other. Matter, they said, is extended; mind is unextended. Matter is ponderable, that is to say, has weight; while mind is imponderable. Matter is divisible into parts; mind is an indivisible unity. On

the other hand, mind thinks, and may also be the object of thought; while matter is the object of thought, but does not think. Mind is active; matter is passive. Mind was called by the Cartesians *res cogitans,* or "thinking substance"; while matter was called *res extensa* or "extended substance." These terms indicate the completeness of the distinction between the two kinds of being. Matter is extended, but does not think; mind thinks, but is not extended. In other words, the essence of matter is extension, and the essence of mind is thought. John Locke in a famous passage suggests that the same substance *might be* both extended and thinking; but for the most part the Cartesians failed to consider this possibility. They assumed that what is extended does not think, and that what thinks is not extended.

The Problem of Interaction; Occasionalism.—If now these two substances—the thinking substance which is not extended, and the extended substance which does not think—are so completely different from each other, the question arises how they can act upon each other as they seem to do.

This problem is especially urgent in the sphere of human personality, where mind certainly seems to act upon body and body seems to act upon mind. In seeking to evade this difficulty, some of the followers of Descartes developed a curious theory which is known in the history of philosophy as "occasionalism." It attempts to solve the difficulty of interaction by appealing to the agency of Deity. Our minds do not really act upon our bodies, they maintained, but *upon the occasion of a volition* God intervenes to bring about the appropriate bodily movement. For example, I choose to raise my arm to the level of my shoulder. You may think that the act of my will causes the arm to move. Not so, says the occasionalist; the act of will is not the *cause* of the bodily movement; it is only the *occasion.* The cause, in reality, is God.

Suppose, again, that a ray of light strikes the retina of my eye. It produces a change in nervous tissue which in some manner is propagated along the fibers of the optic nerve until it reaches my brain, and I then experience a sensation of bright-

ness or of color. It certainly seems in this case that a change in my body has been the cause of a change in my mind. But this too the occasionalist would deny. Body does not really act upon mind, he says; what really takes place is that the bodily change becomes the occasion for the divine intervention by which the mental state is brought to pass. At the moment when the physical change takes place in my retina, or more accurately in my brain, God puts into my mind the appropriate visual sensation.

But How Can the Divine Spirit Produce Changes in Matter?—Thus in general, according to the occasionalists, it is a mistake to suppose that a mental event can produce a physical event, or that a physical event can produce a mental event; but at the moment when a certain mental event occurs God intervenes to produce the corresponding physical event, and at the moment when a certain physical event occurs He intervenes to produce the corresponding mental event. The occasionalists, however, overlooked an obvious difficulty. For if we divide reality into two classes, one consisting of instances of "thinking substance" and the other of instances of "extended substance," God, the Divine Spirit, would naturally be classified as *res cogitans*. But if *res cogitans* is unable to act upon *res extensa,* how is it that God is able to produce changes in matter?

Two reasons may be suggested to explain what seems to us to be a glaring defect in the thinking of the occasionalists. In the first place they would seem to have been vaguely feeling their way toward the view afterwards held explicitly by Spinoza, namely, that God is neither mind nor matter, but rather the fundamental reality of which both mind and matter are partial manifestations.

And in the second place, upon them as upon many of us the very name "God" casts such a spell as virtually to paralyze the critical faculty. To say that God could not act upon matter would seem to them to be absurd; for are not all things possible with Him? Is not God omnipotent? To the twentieth-century thinker, however, it will probably seem no harder to suppose

that the mind of an individual human being can act upon his body than to suppose that God can act upon all bodies.

The New Occasionalism.—We must conclude, then, that the occasionalism of the Cartesians fails to solve the problem which they set for themselves. Interaction, however, appears to be a fact, whether we can explain it or not. We need not repeat our discussion of the alleged incompatibility of the theory of interaction with the principle of the conservation of energy. As we saw in Chap. VII, this difficulty is merely a puzzle which does not survive a critical examination. (See pp. 204 f.) And the importance of the problem of interaction has been magnified unduly, largely because, while mind and body have been regarded uncritically as two radically different substances, it has been supposed that the interaction of two portions of the same substance presents no difficulty. As a matter of fact, it is not obvious that there is any more mystery in the action of mind upon matter, or of matter upon mind, than there is in the action of one bit of matter upon another bit of matter. Indeed, the recognition of the fact that *all* interaction requires explanation just as badly as does interaction between mind and matter is the fundamental element in the doctrine of causation which I have called "naturalistic occasionalism." (See pp. 155 ff.)

This new occasionalism differs, however, from the occasionalism of the Cartesians in that it does not include an appeal to divine agency. Nothing is really gained either in philosophy or in daily life *by taking the name of God in vain.* The new occasionalism does not use the divine name in a vain attempt to bridge the chasm between cause and effect; but simply recognizes as a fact the existence of discontinuities; and suggests that in general we have no right to assume that the effect is either a part of the cause, or similar to the cause, or still less, that it is identical with it or a logical implicate of it.

2. Monistic Theories

The argument that dualism should be rejected on the ground that it involves interactionism must, I think, be given up. Inter-

action appears to be a fact; and any solution of the mind-matter problem must somehow make room for this appearance.

But are the entities which thus appear to interact genuine existents? Is it true that they are both *substances?* Is it not possible that one or the other side of the apparent dualism of mind and matter may be a delusive appearance rather than an actual existent; or if the genuine existence of both kinds of reality must be admitted, is it not conceivable that while one of them possesses genuine substantiality the other is a relatively transitory emergent?

The latter suggestion will be considered in the concluding section of this chapter. The present section will be devoted to an account of several kinds of monism; all of which, much as they differ from each other, agree in regarding one or the other side of the apparent dualism as delusive.

Materialism.—Of all these monistic theories of the nature of being, the one which is at first sight the most plausible is the view known as *materialism*. In its more extreme form, this theory maintains that nothing exists except matter. A more moderate form of the materialistic doctrine is content to assert that matter is the fundamental reality, without denying that some sort of quasi-reality may be attributed to mind also.

According to the former interpretation, consciousness, or mentality, would have to be regarded as a delusive appearance of properties which are in reality properties of matter. The milder form of materialism, which, while allowing a quasi-reality to mind, insists that matter is the fundamental reality, obviously shades off into dualism or the emergence theory; for if by "reality" we mean *existence* (and if the terms of discourse are to be employed significantly, what else can we mean?), the term "quasi-reality" stands for a merely verbal compromise. This milder form of the doctrine need not, then, detain us. It is manifest that no middle ground is possible; either mind exists or else it is delusive.

Materialism must accordingly stand or fall with the suggestion that mentality is a delusive appearance of the properties of

materiality. This, however, does not seem to be a tenable position. For an appearance must be, not simply *of* something, but also *to* something; and it would follow that if mind is but a delusive appearance of matter, that which we designate by the term "matter" must be the *subject* as well as the *object* of cognition. (See p. 215.) Again, mind as known introspectively by each one of us obviously includes elements other than the properties such as motion, extension, etc., which are commonly assigned to matter. If then our introspective experience is assumed to be veridical, all the properties which are found in mind must be regarded as belonging to matter. On the other hand, if this experience is assumed to be non-veridical, matter must be regarded as capable of misjudging its own properties, viewing them erroneously as properties of mind.

In short, materialism in seeking to account for so-called mind is compelled to give to matter a wealth of properties such as make this "matter" something very different from what we ordinarily understand by the term. Now it may be that there is some one substance which has all the properties of both mentality and materiality; but the view thus arrived at would no longer be materialism, but a form of the "double-aspect theory," or of "neutral monism." (See pp. 321 ff.)

Idealism.—While materialism is superficially plausible, it does not, then, survive a critical examination. And the type of monistic theory which has had the most widespread acceptance among philosophically trained men is, no doubt, *idealism;* although in recent decades this point of view seems to be losing ground. Idealists differ greatly among themselves, as we shall see, in working out the details of the theory, but there is one proposition upon which they all agree. It is the thesis that *everything which exists is mental;* or, negatively expressed, *nothing exists except minds and the contents of minds* (ideas). Suppose now that we accept this thesis. Let us assume, for the sake of the argument, that anything which may be mentioned is either a mind or else is included among the contents of a mind. What should we say, then, of things which are commonly con-

sidered inanimate? What should we say, for example, of tables and chairs and telephone poles? Is a chair a mind, or is it included among the contents of a mind? Let us make a list of possible answers:

(1) A chair is an idea (a content of mind).
(2) A chair is a group of ideas.
(3) A chair is a mind.
(4) A chair is a group of minds.
(5) A chair is a part of a mind.

These five seem to me to exhaust the significant answers which a consistent idealist or mentalist could give to our question. A sixth possibility might, indeed, be suggested, to the effect that a chair might be regarded as a part of an idea. Inasmuch, however, as a part of an idea would itself be an idea, this is hardly distinguishable from (1). Of our five logically distinguishable idealistic accounts of the nature of a chair, numbers (1) and (3) have not, so far as I know, been defended by anyone. The other three points of view, however, have had eminent representatives in the history of modern thought. Number (2) manifestly illustrates the type of idealistic theory developed by Berkeley; while Numbers (4) and (5) exemplify, respectively, the positions of Leibniz and Hegel. These varieties of idealistic theory are known respectively as "subjective idealism," "monadistic idealism," and "absolute idealism."

Subjective Idealism.—We have already discussed the subjectivism of Berkeley. (See Chap. VIII, pp. 243 ff.) We saw that the good bishop's paradoxical denial of the independent reality of material substance was motivated by a desire to confute the enemies of religion. Berkeley himself liked to call his theory "immaterialism," because it was diametrically opposed to materialism. He believed in the existence of a plurality of finite minds, together with the Supreme Mind. So-called matter, he maintained, has no existence *extra mentem,* but has quasi-reality as a system of ideas within minds. Why then is the world as known by each of us approximately the same? Because, an-

swers Berkeley, the Supreme Mind puts approximately the same ideas into all of our minds. Why do natural phenomena occur in regular sequences, so that nature appears to be a realm of law and order? Because God in His beneficence gives us our perceptions in this way. Indeed, according to Berkeley's theory, what we call "nature," the world of animals, plants, and inanimate things, *exists* only in the sense that God constantly produces it as a harmonious system of ideas in our minds. Nature, then, has no *objective* existence, but is entirely *subjective*. In this respect Berkeley's theory differs from the theories of Leibniz and Hegel, which attribute independent reality to so-called inanimate things, and are therefore known as types of *objective idealism*.

Monadistic Idealism.—While Berkeley regards the world of material objects as nothing but a system of ideas put into our minds by the divine Mind, according to Leibniz the world is itself a system which comprises many minds. Sticks and stones, chairs and tables, toothpicks and telephone poles, all the so-called dead things of the world, are not really dead, according to Leibniz, but each consists of a multitude of little souls or selves or minds, which he calls "monads."

The monads are then the ultimate units of which all things are composed. We are reminded of the molecules of the physicist, or of the atoms of the chemist. Leibniz's monads, however, differ from the molecules, atoms, etc., of the materialists in that they are alive and in some degree conscious. While all of the monads are alive and conscious, some of them are more fully alive and more clearly conscious than others. The drowsiest and least lively of all the monads are those which compose the so-called dead things (which, however, according to Leibniz, are not really dead), such as rocks and dry sticks. The monads which compose the plants do not sleep quite so soundly. A little more wide-awake than the vegetable monads are those which make up the bodies of animals and of men. The monads which we call human minds or selves have longer or shorter periods of relatively clear consciousness. While in God, the Supreme

Monad, consciousness is found in the highest degree. Thus, according to monadistic idealism, there is a continuous gradation of beings ranging all the way from the Supreme Monad to the monads which compose the so-called inanimate things.

Leibniz needlessly complicated his theory by adding certain doctrines, as that there is no interaction between the monads, and that the Supreme Monad is somehow the source and ground of all the others. Aside from these doctrines, which are inconsistent with each other and introduce unnecessary difficulties, Leibniz's form of idealism seems to me to be the most plausible of all the idealistic theories. At any rate, it is less open to destructive criticism than the theory of Berkeley. (See pp. 245 f.)

Absolute Idealism.—In order to understand the difference between the idealism of Hegel and the two varieties of idealism which we have already discussed, it is necessary to touch briefly upon an issue to which we have several times referred, and which will be taken up in somewhat greater detail in the next chapter. This is the issue between the singularists and the pluralists. According to the former, the so-called *parts* of the real are so closely inter-related that all that exists is really only one all-inclusive Being. The pluralists deny this, and insist that reality consists of a multitude of relatively independent parts.

It is obvious that Berkeley, who believed in a multitude of minds, and Leibniz, who believed in a multitude of monads, were pluralists. Hegel, however, was a singularist. According to his form of idealism, there is in reality only one Mind, and all so-called other minds, as well as all so-called material things, are parts of this all-inclusive One.

This all-embracing Mind is called the Absolute. The Absolute alone possesses genuine reality. Here we have a point of contact between Hegel's doctrine and that of the mediæval realists. Each of us is real only in the sense that we are identical parts of the Absolute. The same is true of animals and plants, of sticks and stones and telephone poles. We are all parts of the Absolute in the same sense in which Center County is a part of Pennsylvania!

In many respects, Hegel's theory is similar to the theological doctrine known as "pantheism." For the Absolute may be identified with God. In the Absolute we live and move and have our being. In the Absolute all contradictions are reconciled; all hopes fulfilled; all sorrows assuaged; all evil overcome.

The psychological, ethical, and logical objections to absolute idealism will be considered in the next chapter. Great as is its poetical and aesthetic attractiveness, considered as a sober account of the nature and structure of the real it will be found to be very questionable.

The Double-Aspect Theory.—Absolute Idealism tends to shade off into another form of monistic theory known as the "double-aspect theory." This theory is usually associated with the name of Spinoza. It is also a singularism, and was developed in opposition to the dualism of the Cartesians. Instead of two distinct substances, *res cogitans* and *res extensa,* Spinoza recognizes but one substance, to which he gives the name God. God, the ultimate and only substance, has an infinity of attributes. Of these, however, only two are known to us. These are mentality and materiality.

It is to be noted that, according to this theory, neither mind nor matter is, in the strict sense, a substance. For Spinoza defines a substance as "that which exists by itself and is conceived through itself." And since mind and matter are attributes of God, they are not substances. The real substance is then neither mind nor matter; and yet there is a sense in which it is *both* mind and matter. The double-aspect theory may be illustrated by drawing a curve and then asking whether it is concave or convex. The answer obviously depends upon the way you look at it. Just as the curved line has two aspects, one concave and the other convex, so the one ultimate substance is said to have two aspects, one material and the other mental.

An objection which has often been urged against the double-aspect theory of the mind-body relation is that in speaking of two "aspects," the theory seems to presuppose the existence of an observer, and thus of a mind which is not one of the two

aspects. It seems to me, however, that the objection holds against the figure of speech underlying the phrase "double-aspect," rather than against the real intent of the theory; and that it might be met by speaking of the one substance as having two kinds of *activity* instead of two *aspects*.

A more serious objection to the double-aspect theory is that its ultimate substance appears to be unknowable; and nothing is gained by seeking to explain mind and matter, about both of which we know at least a little, by regarding them as aspects or activities of a *tertium quid* concerning which we confessedly know nothing at all.

Finally the double-aspect theory, as formulated by Spinoza, is a form of singularism; and as such is exposed to the difficulties which, as we shall see in the next chapter, make the singularistic position ethically and logically objectionable.

The Doctrine of Neutral Entities.—A variety of monistic theory which is closely related to the double-aspect theory, but should be distinguished from it, is the doctrine of "neutral entities," or "neutral monism," as it is also called, which is held by some of our contemporary realists. (See Chap. VIII, p. 258.) As in the double-aspect theory, ultimate reality is neither mind nor matter, but has the potentiality of both. While the double-aspect theory, however, is singularistic, our contemporary neutral monism is pluralistic. And this pluralism gives it a certain advantage. Instead of but one Being or Substance that manifests itself in two fundamentally different ways, there are assumed to be a multitude of "neutral entities," which may appear as matter or as mind or as both at once. Whether a given entity or group of entities shall be material or mental or both depends entirely, it is held, upon the type of organization of which it forms a part. Just as a man may become a member now of this organization and now of that, and then perhaps of two or more organizations at once; so a neutral entity by virtue of membership in one type of structure may be *physical*, and by virtue of its membership in another type of structure be *psychical*.

This theory, however, is exposed to the criticism registered a moment ago against the double-aspect theory, that its concept of *neutrality* is void of content. If the neutral entities do not have the qualities of either materiality or mentality, what qualities *do* they have? The neutralist may, perhaps, reply that materiality and mentality are not simple qualities, but rather complexes of qualities; and that all that is meant by the denial that the ultimate units are mental is that they do not have *all* the qualities which constitute mentality; and all that is meant by the denial that they are physical is likewise that they do not have *all* the qualities which constitute materiality. It would then be possible to assume that the neutral entities, even as neutral, have some of the elemental qualities of mentality or of materiality or of both; and that the appearance of the remaining qualities is dependent upon the entrance of the entities into specific types of structure.

Thus qualified, however, the theory of neutral entities would scarcely be distinguishable from the theory of "emergent neutralism," which is to be discussed in the latter part of the next section. (See pp. 328 ff.)

3. Theories of Emergence

In spite of all that can be said in favor of the various monistic theories of the nature of reality, some form of dualism seems to be unescapable. Those who call themselves materialistic monists must nevertheless admit the existence of so-called mind; and those who call themselves idealists or spiritualistic monists must nevertheless admit the existence of so-called matter. In either case it is necessary to recognize two radically different manifestations or kinds of activity. According to the materialist, there are two radically different kinds of activity of *matter*—motion, impenetrability, etc., on the one hand, and awareness, feeling, volition, etc., on the other. According to the idealist, there are two radically different kinds of activity of *mind*—awareness, feeling, volition, etc., on the one hand, and motion, impenetrability, etc., on the other. The double-aspect theory and

neutralism, too, are merely formal unifications of these radically diverse types of activity.

Traditional dualism, however, seems to have exaggerated the independence and permanence of one, at least, of the two types of reality. For it has commonly affirmed that both types of being are *substances;* and in calling them "substances" it has meant to assert that they are both eternal, or at least relatively *permanent.* Now, while permanence can fairly be affirmed of *material* substances, it must be admitted, I think, that *mental* events are too impermanent to be regarded significantly as substantial. For, as we saw in Chap. VII, the series of psychical "states" associated with a given physical organism is empirically *discontinuous.*

We still remain dualists, then, in the sense that we recognize the existence of two irreducible kinds of being; but we are also monists in that we regard the one kind of being as much more substantial than the other. Thus traditional dualism and traditional monism find their reconciliation in the conception of "emergence."

Degrees of Substantiality.—In other words, the traditional dispute between the dualists and the monists presupposes a hard and fast distinction between substance and that which is not substance. Two requirements have usually been insisted upon before any given entity can be admitted to the rank and dignity of a substance. In the first place, to be a substance an entity must be capable of existing independently. This seems to mean that it might conceivably continue to exist even after everything else had vanished into nothingness. In the second place, to be a substance an entity, as we have already pointed out, must be permanent. And in practice the latter requirement becomes the actual test of substantiality. For the only way we can tell that a thing is able to exist alone is to observe that it does, at some time, exist in the absence of other things with which it is usually associated. Thus unless a thing is permanent it cannot be regarded as a substance. It might conceivably be permanent without being substantial; but it could not be substantial without being permanent.

But if permanence is, in practice, the essential element in the conception of substance, it is important to recognize that permanence is itself a *relative* term. "The plain man says that a flash of lightning or a twinge of toothache is too transitory to be a substance, but holds that a human body lasts long enough to be a substance. But this is obviously rather arbitrary. The duration of a human body is very small as compared with that of a mountain. Thus, if the distinction is to turn on mere duration, it seems difficult to find any safe resting place between the two extreme views of Dr. McTaggart and Spinoza, *viz.*, that every particular existent, however transitory, is a substance, and that no existent can count as a substance unless it is eternal. . . . Now I would suggest that it is quite reasonable to talk of 'degrees of substantiality.' *Caeteris paribus,* an existent is more of a substance the longer it lasts and the less dependent it is on anything else. . . . I should say that the solar system is much more substantial than my body; and that my body is much more substantial than a sneeze; and that the whole material world, if it forms a single self-contained physical system, is still more of a substance than the solar system." [2]

Mind as Substance or as Emergent.—The issue is therefore not so clear-cut as either the dualists or the monists have usually supposed it to be. The question is not simply whether both mind and body are substances, or whether one or the other of them ought to be called a delusive appearance. The question is, rather, what *degree* of substantiality can rightly be accorded to each of them. From one point of view any event whatsoever, however transitory it may be, is a substance; from the other point of view, neither our minds nor our bodies—nor anything else, unless it be the Whole—are sufficiently permanent and independent to be regarded as substances. Either interpretation, however, would make the term "substance" an almost useless word.

It seems to be more convenient, accordingly, to reserve the word "substance" for such existents as endure for a relatively

[2] Broad, C. D., *The Mind and Its Place in Nature,* 1925, pp. 29 and 31.

long time; and to employ the name "emergent" for such entities as are relatively transitory. If we now raise the question whether minds and bodies are substances, there are at least three logically distinguishable theories:

(1) Matter may be emergent, and mind substantial.

(2) Mind may be emergent, and matter substantial.

(3) Both materiality and mentality may be emergent qualities.

The first of these three theories has been called by Broad "emergent mentalism." [3] In view, however, of the conclusions to which we came in Chap. VII, we cannot regard this theory as worthy of serious discussion. For we found it reasonable to believe that the series of psychical events is causally discontinuous; and therefore if either mind or body is to be regarded as an emergent, it must be the former rather than the latter. Indeed the phrase "causal continuity" which we employed in that discussion might conveniently be taken as a synonym of (relative) "substantiality."

If then we are unable to accept dualism, we still have a choice between the theory that mind is emergent and matter substantial, and the theory that both mentality and materiality are emergent qualities. The former of these is called by Broad "emergent materialism" and the latter "emergent neutralism." They agree in regarding mind as emergent, but differ in their account of the qualities of that which is, so to speak, the *occasion* for its emergence.

Emergent Qualities Neither Reducible nor Delusive.—Before going on, however, to discuss these alternative forms of the emergence theory, it may be well to guard against a possible misunderstanding. "'Emergence,'" says Professor Lovejoy,[4] "may be taken loosely to signify any augmentative or transmutative event, any process in which there appear effects that, in some one or more of several ways yet to be specified, fail to conform to the maxim that 'there cannot be in the consequent

[3] It is to be noted that in Broad's terminology, in the phrases "emergent mentalism," "emergent materialism," and "emergent neutralism," the *noun* in each case refers to that which is *not* emergent.

[4] *Journal of Philosophical Studies,* Vol. II, No. 6, p. 169.

anything more than, or different in nature from, that which is in the antecedent.' " The theory of emergence is then roughly the same as our theory of "naturalistic occasionalism." The reader will remember that in Chapter V (p. 157) we made use of this conception in explaining the difference between thoroughgoing mechanism and the "theory of levels." And in discussing the origin of the individual self (p. 219), we spoke of the emergence of mentality when the organism reaches a certain stage of development. The idea of emergence is also implied in our account of "Interactionism (c)," according to which the series of mental events is discontinuous while the physical series is unbroken, certain complex combinations within the latter being the occasions for the initiation of longer or shorter portions of the former.

It should be clearly understood, though, that when we speak of mental events as emerging upon the occasion of a certain arrangement of physical processes, we do not mean that mentality can be reduced to material qualities, nor yet do we mean that mentality is a delusive appearance. To say that mentality is a *reducible* quality would mean that it could be *deduced* from a knowledge of the material or other qualities of the occasion upon which it emerges. This, however, is obviously impossible. Neither can mentality be said to be a delusive characteristic. This, to employ Broad's terminology, is the error of "pure materialism"; and we have already shown the untenability of this position. (See pp. 316 f.)

Emergent Materialism.—We are now ready to return to the discussion of our alternative forms of the theory of emergence. We consider first the view that mentality is emergent and materiality substantial. This theory agrees with the data of empirical psychology. There are many material things which *seem,* at least, to be without the quality of mentality. Moreover, so far as immediate experience goes, even we who know ourselves to be conscious are not conscious all the time. Consciousness seems to be a function of the condition of our physical organisms, especially of our nervous systems. Yet, while mind

is not sufficiently continuous to be regarded as a substance, it is not a merely passive spectator. It is transitory; but while it lasts, is efficient. This theory is in accordance with our "Interactionism (c)," as expounded in Chapter VII, and with the theory of cosmic teleology developed in Chapter III.

The theory, it is to be observed, is called emergent *materialism,* not because it is matter which emerges, but because it is matter which provides the occasion for the emergence of mind. It is to be hoped that no one will be prejudiced against it on the ground that materialism has been much spoken against as an evil doctrine. In the first place, emergent materialism is to be sharply distinguished from traditional materialism, which as we saw above, is either reductive or delusive. According to *emergent* materialism, mind is not merely a summation or rearrangement or vastly increased complexity of physical process, but it appears upon the scene as a new existent; and while it lasts it is just as real as any element of its physical occasion.

Emergent Neutralism.—This variety of the theory of emergence differs from the view which we have just discussed in its account of the nature of the ultimate substance. It bears about the same relation to the double-aspect theory and the theory of neutral entities as emergent materialism bears to the traditional materialism. According to this view, both mind and matter are emergents; and the ultimate substance, the occasion for the emergence of the qualities of mentality and materiality, is itself *neutral.*

As a compromise between this and the preceding variety of the theory of emergence, we may mention the hypothesis that there are, so to speak, two stages in the emergence of mind out of the ultimate neutral substance. First matter emerges; and then matter provides the occasion for the emergence of mind.[5] This hypothesis would be in line with the idea hinted at in Chapter V that the protons and electrons, the ultimate units of which matter is composed, may not themselves be material. And it would agree further with those mathematical theories of

[5] Cf. Alexander, S., *Space, Time, and Deity,* 1920.

reality in accordance with which matter is explained as a property or group of properties of space-time. Thus gravitation, cohesion, inertia, etc., the various factors which constitute the quality of materiality, would be thought of as emerging out of the purely extensive properties of space-time.

Conclusion.—Mr. Broad, upon whom we have been leaning pretty heavily in this section (but who would no doubt consider our exposition very superficial), distinguishes seventeen logically possible theories concerning the status of mind.[6] Many of these have of course been included merely for the sake of completeness of analysis, and not because anybody could wish to defend them. As Broad himself points out, all theories which treat mentality as a *delusive* characteristic, and all theories which regard either mentality or materiality as *reducible,* are clearly untenable. Thus the number of theories which may be considered as more or less serious contenders is reduced to half a dozen:

(1) Dualism.
(2) Pure mentalism.
(3) Emergent mentalism.
(4) Emergent materialism.
(5) Emergent neutralism.
(6) Mentalistic neutralism.

Of these six theories, *pure mentalism* is, to say the least, as we saw in discussing Berkeley's type of idealism (see pp. 318 f), logically inconvenient. It would consider mind as the substance and matter as but a delusive appearance. Concerning *emergent* mentalism, which would regard mind as the substance and matter as the emergent, we need only repeat what we said above (p. 326), namely, that if there is any difference in degree of substantiality, matter is more substantial than mind. For the same reason, dualism would have to be rejected; for as it is usually expounded it regards both mind and matter as coördinately and in the fullest sense substantial.

[6] See Broad, C. D., *The Mind and Its Place in Nature,* 1925, pp. 607 ff.

This leaves *emergent materialism* and the two forms of *neutralism* as the types of theory which ought to be seriously considered. All of these agree in regarding mentality as an emergent characteristic, but differ in their account of the nature of the situation which constitutes the occasion for its emergence. According to *emergent materialism,* while mentality is emergent, materiality is substantial.[7] *Emergent neutralism,* on the other hand, does not regard even matter as substantial, but holds that both mentality and materiality are emergent; while *mentalistic* neutralism, as defined by Broad, goes even further in denying the substantiality of matter, for it regards mentality as an emergent characteristic but materiality as delusive. Just how we are to think of this neutral somewhat, which somehow becomes the occasion for the emergence of mind, and for the delusive appearance of matter, is not at all clear.

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[7] Or as suggested above (see pp. 328 f.), matter after itself emerging becomes the occasion for the emergence of mind.

CHAPTER XII

THE INTER-RELATEDNESS OF THE REAL

Mere information is not science. There is a bird's nest in the pasture; a cloud has just now passed over the sun; yesterday an automobile upset on the highway; the leaves of the maple trees are coloring; my baby brother has ten toes; I have a headache this morning—all of these are interesting items of information; but they are not science. For only knowledge that is *organized* is properly called science. Disconnected items of information may have a rightful place in a scrapbook; but information becomes science only when it is classified and reduced to a system.

Science, then, is not simply a search for hitherto unknown facts; it is also, and much more, a search for *connections* among facts. It seeks to discover *laws* and *causes*. As we saw in Chapter X, one of the fundamental postulates of descriptive and explanatory science is the assumption that the parts of the real are inter-related. And some persons in their enthusiasm for a logical and mathematical view of the universe have understood this to mean that science postulates the unity of all things. We however sought to qualify the postulate of inter-relatedness by pointing out that all that science needs to assume is that, at any given stage in the progress of discovery, there is *more* inter-relatedness than has *as yet* been discovered. In other words, science is the attempt to find just as much unity in the universe as it possibly can; but we have no right to affirm in advance that the universe is absolutely one.

1. Singularism and Pluralism

The question of the amount of unity in the universe gives rise to the issue between the singularists and the pluralists. For

the fact that we speak of the sum-total of things as a "universe" rather than as a "pluriverse" or "multiverse," no more requires us to admit that the real is *one* than the fact that we continue to speak of "atoms" requires us to think of the chemists' units as indivisible. Those who are chiefly interested in finding as much unity as possible in this universe of ours are, of course, the singularists; while those who are chiefly concerned to see to it that, in our enthusiasm for unification, we shall neglect or overlook nothing which ought to be taken into account, are the pluralists. Thus stated, there is of course no clear-cut issue between the two schools, but rather a difference of tendency or emphasis.

Two Questions about Reality.—In the preceding chapter we discussed the problem of the ultimate stuff or stuffs of which all things may be thought to be composed. It is important to remind ourselves, however, that the problem of reality is twofold. In addition to inquiring concerning the *nature of being* we must also inquire concerning the *number of beings*. There are then two distinct questions: (1) How many kinds of being? and (2) How many beings?

Suppose you should ask a collector how many butterflies or coins or stamps or match boxes, as the case may be, he has in his collection. He might understand your question in either of two senses. He would probably interpret it, I suppose, as an inquiry concerning the number of different kinds of objects; but he might also interpret it as referring to the number of objects, irrespective of kind.

In the same way the problem of reality is a double problem; and although in actual discussion it is impossible to keep them apart, it is important to see that the two questions are logically distinguishable. After inquiring whether there are two kinds of being—mind and matter—, or but one kind of being—mind or matter or a neutral somewhat—we may next inquire whether there are many beings or only one. In other words, it is theoretically possible for those who hold that there is but *one kind of being* to maintain that there are *many beings*.

Unfortunately, the term "monism," which we employed in the preceding chapter to denote the theory that there is only one kind of *substance,* is also employed to denote the theory of but one being. Some writers distinguish between the two senses of the term by referring to the former theory as "qualitative monism" and to the latter as "numerical monism." It seems to be more convenient, however, to employ the term "singularism" for the theory of one being, and to reserve the term "monism" for the view that there is but one *kind* of being.

It is manifest that the term "pluralism" is similarly ambiguous. In this chapter, however, we shall understand it to be the opposite of singularism.

Outline of Theories.—A diagram may help us to see the relation between the traditional theories:

- Ontology
  - Dualism
  - Monism
    - Materialism
    - Mentalism or Idealism
      - Subjective
      - Monadistic
      - Absolute
    - Double-Aspect Theory
    - Neutral Monism
- Cosmology
  - Singularism
  - Pluralism

Singularism and Idealism.—A combination of singularism with materialism would be so obviously impossible that I know of no philosopher who has defended it. Materialism, with its molecules, atoms, and electrons, has always been pluralistic. Idealism, on the other hand, has in some cases been pluralistic, and in other cases singularistic. Thus Berkeley and Leibniz were pluralists; for the former recognized the existence of a plurality of finite minds in addition to the Supreme Mind, while the latter recognized a plurality of monads of various degrees of consciousness. Hegel, however, as we saw in the preceding chapter, was a singularist. His "absolute idealism" regards all things as parts of the one all-inclusive Spirit.

The Singularism of Spinoza.—Hegel describes the one being, the Absolute, as Spirit. According to Spinoza, however,

the fundamental reality is neither spiritual nor material, but is characterized simply as *substance.* And, although Spinoza gives to this one substance the name "God," and in his exposition makes use of a theological terminology, he insists that his substance is not personal or even, properly speaking, conscious. "The term God," says Professor Thilly,[1] "is variously employed in the Spinozistic system: He is identified with the universe, or He is identified with His attributes, or He is the absolute unified substance with its infinite attributes, or He is the unified substance itself, higher than these attributes. The real meaning most likely is that God is the universe conceived as an eternal and necessary unity, an organic whole, a unity in diversity."

It is apparent, then, that whatever edification we experience as we read Spinoza's *Ethics,* in which his doctrine of the one substance is expounded, is dependent upon our tendency to personify that which, in reality, is not to be conceived as a person; and that this tendency to personify is increased by Spinoza's paradoxical employment of the term "God." If we would avoid misunderstanding, then, we must always remember that Spinoza's "God" is simply the ultimate substance, which is itself, strictly speaking, neither mind nor matter, but which has as two of its "attributes" mentality and materiality. In other words, Spinoza is not in the strict sense of the term an *idealist,* but a representative of the "double-aspect theory."

The Singularism of the Upanishads.—Both the Hegelian and the Spinozistic types of singularism have points of contact with views entertained by some of the early Hindus and preserved in the sacred literature known as the Upanishads. Everything, according to the Hindu sages, is Brahman. All belongs to the one World, the one Reality, the one Soul. We must not, however, feel ourselves to be lost in the immensity of the Whole; for, as the sages hasten to assure us, "That art thou."[2] This seems to mean that, while all things are One, each of us is not merely a part of that One, as a drop of water may be

[1] *History of Philosophy,* 1914, p. 307.
[2] Royce, J., *The World and the Individual,* 1899, p. 82.

thought to be a part of the great ocean, but each one of us *is* the One in all its wholeness.

"What is, is at all events somehow One. This thought came early to the Hindu religious mind. . . . The world is One—Why? *Because I feel it as one.* What then is its oneness? *My own oneness.* And who am I? I am Brahman; I myself, in my inmost heart, in my Soul, am the world-principle, the All." [3]

This, of course, is pantheism. And pantheism has always appealed to the poet and the mystic. It would thus be possible to cull from nearly all of the greater poets passages which illustrate the singularist point of view. In particular, the student should read Emerson's little poem "Brahma" in order to gain a sympathetic understanding of Hindu pantheism.

> If the red slayer think he slays,
> Or if the slain think he is slain,
> They know not well the subtle ways
> I keep, and pass, and turn again.
>
> . . . . .
>
> They reckon ill who leave me out;
> When me they fly, I am the wings;
> I am the doubter and the doubt,
> And I the hymn the Brahman sings.[4]

Singularism in Ancient Greece.—A very extreme type of singularism was taught by an ancient Greek thinker named Parmenides (about 475 B.C.). The doctrine of the One had been developed in the first place by his teacher Xenophanes as a protest against the polytheism and anthropomorphism of the popular religion. Parmenides carried over the doctrine of the One from theology to metaphysics. Identifying God with fundamental being, he asserts that being is One; and furthermore that this One is eternal, underived, unchangeable, and immovable. Zeno, a disciple of Parmenides, attempted to support the doctrine of his master by propounding several curious arguments against the possibility of motion.

[3] *Ibid.*, pp. 156 and 158.
[4] For the entire poem, see *The Harvard Classics*, 1910, Vol. XLII, p. 1294.

You and I, to be sure, might offer objections to the doctrine of Parmenides. We might object that it is impossible that there should be only one being; for we can count more than thirty persons in this room. Or we might urge that it is foolish to say that motion is impossible, because we can see the branches of yonder tree swaying back and forth in the wind. To both of these objections Parmenides would no doubt reply that he and his disciples desire to know *the truth;* while we are satisfied with *appearance.* They believe in following reason, while we are slaves of our senses. In other words, Parmenides and his school would contend that motion and multiplicity are illusions. If you should tell them that their doctrine is contrary to the facts, they would reply, "So much the worse for your facts."

Singularism and Eternalism.—Not only must the disciple of Parmenides treat the data of sensation as illusory, but singularism usually involves a denial of the reality of time. The Absolute is said to be *eternal;* and this does not mean simply that the life of the Absolute is *everlasting,* but that it is *supertemporal.* In other words, the experience of the Absolute is said to be timeless, or to transcend time. When we come to inquire a little more closely, however, we find some uncertainty as to the precise meaning of these statements. Sometimes the meaning appears to be that time is unreal, that it is an illusion. And yet, if our experience that one thing comes *after* another is illusory, what, then, is real? Sometimes, however, instead of denying the reality of time, the singularist affirms that time is real, but that the Absolute experiences it all at once.

"The events of the temporal order," says Royce, "are divided, with reference to the point of view of any finite self, into what now is, and what *no longer* is, and what *is to be,* but is *not yet.* These same events, however, in so far as they are viewed at once by the Absolute, are for such view, all equally present. And thus their presence is the presence of all time, as a *totum simul,* to the Absolute. And the presence, in this sense, of all time at once to the Absolute, constitutes the Eternal order of

the world,—eternal, since it is inclusive of all distinctions of temporal past and temporal future,—eternal, since, for this very reason, the totality of temporal events thus present at once to the Absolute has no events that precede or that follow it, but contains all sequences within it,—eternal, finally, because this view of the world does not, like our partial glimpses of this or that relative whole of sequence, pass away and give place to some other view, but includes an observation of every passing away, of every sequence, of every event and of whatever in time succeeds and follows that event, and includes all the views that are taken by the various finite selves." [5]

Ethical Objections to Singularism.—It must be admitted that Royce's eloquent description of the eternal order of the world as a *totum simul* in the experience of the Absolute is very plausible. "An eternal knowledge," continues Royce,[6] "is often spoken of as if it were one for which there is *no* distinction whatever between past, and present, and future. But such a definition is as absurd as if one should speak of our knowledge of a whole musical phrase or rhythm, when we grasp such a whole at once, as if the *at once* implied that there were for us no temporal distinction between the first and the last beat or note of the succession in question. To observe the succession *at once* is to have present with perfect clearness *all* the time-elements of the rhythm or phrase just as they are. . . . Now for our theory, that is precisely the way in which the eternal consciousness views the temporal order."

Difficulties emerge, however, when we attempt to build a doctrine of human conduct upon the foundations offered us by the singularists. In the first place, our conception of human *progress* seems to be irreconcilable with the singularistic position. In spite of all that may be said of the reality of temporal distinctions *within* the Eternal order, the idea that all time and therefore all human history is already completed from the point of view of the Absolute makes human effort and struggle un-

[5] Royce, J., *The World and the Individual,* 1899, Vol. II, p. 141.
[6] *Ibid.,* p. 143.

real. We are then simply play-actors rehearsing a drama the end of which is already achieved at the beginning. Furthermore, according to the singularistic doctrine, the One is regarded, either as beyond good and evil, or else as already perfectly good. The error and suffering and sin of our finite lives are all due to the fragmentariness of our experiences. When taken up into the completeness of the Universal Self, all the imperfections of existence cancel out, or better, all are required to constitute the perfection of the Whole. We, as fragments of the Absolute, may be victims of misfortune, unhappy, discontented, sinful; but the Absolute is perfectly good.[7] But a question cannot be avoided: if the world is already good, *why* should we attempt the impossible task of making it better? The practical outcome of the doctrine of the Absolute is therefore an attitude of acquiescence. As James puts it,[8] the theory of the Absolute gives us a right "ever and anon to take a moral holiday." But while a holiday now and then may be a good thing, a vacation which lasts all the year round is another matter.

In the second place, the singularistic philosophy destroys the sharp distinction made by common sense between good and evil, right and wrong. This follows immediately from the considerations spoken of in the preceding paragraph. It also results from the conception of the Absolute as a Whole which includes within the one Self all finite selves. If the finite selves are but identical parts of the Absolute—if, to repeat our illustration, they are all parts of the Absolute in the same sense in which Center County is a part of Pennsylvania—it follows that every thought of mine is also the Absolute's thought; every act of mine is also the Absolute's act. But now and then I have a wicked thought; and now and then I do an evil deed. The outcome of the argument is, of course, that we must either admit the presence of evil in the Absolute, or else give up the distinction between good and evil. Now it may well be that the distinc-

[7] Cf. Royce, *The Religious Aspect of Philosophy*, 1910, pp. 444 and 449; also *Sources of Religious Insight*, 1912, p. 224.

[8] *Pragmatism*, 1907, p. 74.

tion made by common sense between good and evil is often too sharp and uncompromising; but we can hardly bring ourselves to discard it altogether.

Psychological Objections to Singularism.—In addition to the ethical difficulties which we have just pointed out, there are certain psychological difficulties in the conception of the Absolute. It may be that these do not hold against the Hindu and Spinozistic types of singularism; but they certainly hold against the Hegelian and Roycean position.

As Leighton remarks,[9] "What chiefly distinguishes our modern European philosopher-pantheists from their congeners of ancient India is the constant endeavor of the Europeans to find place and significance and value in the Eternal One for the various degrees of psychical and spiritual individuality and for the labors, sufferings, and achievements of the historical life of humanity." As we saw above, this endeavor has not been successful. Absolute idealism has tried to "eat its cake and have it too." In attempting to meet the ethical objections to the doctrine of the all-inclusive One, the idealists have exposed their doctrine to psychological objections, which are, if possible, even more serious.

These psychological difficulties result from the circumstance that some of our experiences, which according to the singularistic hypothesis are experiences of the Absolute also, are conditioned by our very finiteness, and therefore cannot be experienced by an Infinite Being. Such experiences are hope and fear, for example. Both of these emotions presuppose some degree of uncertainty with respect to the future; and such uncertainty is incompatible with omniscience. In the same way it is impossible that an omniscient being should ever experience curiosity or the joy of discovery. In a word, the Absolute cannot have the experience of ignorance; for, by hypothesis, the Absolute is in possession of all knowledge. Thus it is likely that you know the maiden name of *your* maternal grandmother; while *I*, in all probability, do not know it. But how can your knowledge and

[9] *Field of Philosophy*, 1923, p. 247.

my ignorance of the same thing co-exist in the mind of the Absolute?

To be sure, if all we mean when we say that a Being is omniscient is that He *knows all about* the experiences of all other beings (in addition to all the other knowledge that He is assumed to possess), then these difficulties do not arise. The Absolute may be assumed without contradiction to know all about our states of mind. He may have perfect knowledge about our hopes and fears, our curiosities and discoveries. He may know that you know your grandmother's name, and also that I am ignorant of it. But the Absolute cannot be assumed without contradiction to include within the totality of His experience our identical experiences of hope and fear, of knowledge and ignorance.

It follows, then, or is included in what we have just been saying, that the sort of double experience of *time* which, as we saw above, has been attributed to the Absolute, is psychologically impossible. God, or the Absolute, is said by Royce and others to know all time in one Eternal Now; and furthermore, He is said to know things in succession. The two kinds of knowledge, however, are psychologically incompatible. Merely *to say* that the Absolute has both kinds of knowledge is no more convincing than it would be to say that a certain plane figure is at the same time both rectangular and circular.

A Logical Objection to Singularism.—In addition to these ethical and psychological difficulties, there is an objection which may be said to be, in a peculiar sense, logical, or perhaps we ought to say, epistemological. The difficulty arises from the fact that singularism presupposes the principle of the "internality of relations." (See Chap. VIII, pp. 254 f., and Chap. X, p. 293.) With this principle as the cornerstone of his argument, the singularist, while admitting that there is a sense in which the universe is many, insists nevertheless that the many reals are not in fact independent of each other and of the Whole which they jointly constitute. On the contrary he maintains that they are so inter-related that each one of them depends for its

nature, and indeed for its very existence, upon the co-presence of all the others.

But if this be granted, it would follow that there is no genuine human knowledge. For it would then be impossible to have genuine knowledge of *anything* without having a knowledge of *everything.* (See pp. 290 f.)

The singularist may perchance attempt to escape from this difficulty by suggesting that, while everything is thus bound up with everything else, some of these relations may for most human purposes be disregarded. This, however, is a dangerous concession; for if it be admitted that some relations may be disregarded, or in other words that they are of negligible importance, it is then only a short further step to the position of the realist, namely, that some relations are non-constitutive, accidental, or "external." And if this be conceded, there is no longer any ground for denying that the universe includes *a multitude of independent reals.*

Pluralism.—And this is, of course, the position of the pluralists. It is important to bear in mind, however, as we have already suggested, that the opposition between the singularists and the pluralists is largely a matter of emphasis. Both recognize the existence of a considerable amount of inter-relatedness, and both recognize the existence of a considerable amount of diversity. The difference is that while the former are always directing our attention to the respects in which reality is, or may be supposed to be, *one,* the latter lay chief stress upon the evidences of discontinuity and multiplicity. Pluralism is to be thought of, then, as a protest against the position of the more extreme singularists, and especially against absolute idealism.

A thoroughgoing pluralism is, of course, no more possible than a thoroughgoing singularism; for, as we have seen, science must postulate the inter-relatedness of the parts of the real. Radical pluralism would be nominalism; and nominalism would make of the so-called universe a chaos rather than a cosmos. (See Chap. VIII.)

There is, however, a more moderate type of pluralism—

indistinguishable, perhaps, from moderate singularism—which admits the presence of order in the universe, but insists upon the presence of *dis*order and *dis*connectedness too. This moderate pluralism is fully aware of the craving of the human mind for the unification of knowledge, and precisely for this reason is somewhat distrustful of the "unifications" which have been proposed.

If it be objected that to admit the existence of disorder and discontinuity is equivalent to the admission that the universe is not completely *intelligible,* the pluralist may reply, I think, that this may very well be true. And if it be true that ultimate reality is only partially intelligible, nothing would be gained by denying the fact. The pluralist may concede that just in so far as we recognize the genuine independence of discrete entities, in that degree our universe becomes unintelligible. And if the universe is found, indeed, to be only partially intelligible, that is a fact of which philosophy would do well to take account. For we do not wish to delude ourselves with the superstition that a complete unification of knowledge is attainable, if, as a matter of sober fact, it is not.

The Ethical Approach to Pluralism: Personalism.—In this moderate pluralism we may distinguish two currents. They are not opposed to each other, but are rather two different approaches to the same point of view. The former lays stress upon ethical considerations; the latter upon considerations of logic and epistemology.

The ethical pluralist, then, is chiefly concerned to vindicate the possibility of the moral life. He wishes at all costs to frame a world-view which will include the conception of moral endeavor and of genuine human values. But if all selves are literally parts of the Absolute, it is a mockery to speak of individual responsibility or of personal values. On that hypothesis all responsibility and also all value would inhere in the Absolute. If I am a part of the Absolute, then my act is the Absolute's act, and my goodness or badness, as the case may be, is merged in the perfection of the Whole.

Thus pluralism appears in the form of *personalism.* If each finite self is really a *person,* it must be, in some measure at least, independent of anything beyond itself. The finite person cannot be regarded as a mere fragment of the Absolute; and the values with which human beings are concerned cannot be viewed as so many aspects of the unchanging perfection of the Whole of being; but each person must be, as it were, a moral unit, himself the subject in whom moral values inhere.

Here, however, a perplexity arises for the personalist. If the finite selves are outside, and relatively independent, of the Absolute, it follows that the so-called Absolute *is not really absolute.* For in the degree in which the finite selves are independent, in that same degree the Supreme Self is limited by the co-presence of all the others. In short, the Supreme Self, on the pluralistic hypothesis, is *finite.* Thus personalistic pluralism arrives at the doctrine of a "Finite God." (For a further discussion of the doctrine of the "Finite God," see Chap. XIV.)

The Logical Approach to Pluralism.—We have already spoken of the objection to thoroughgoing singularism which arises from the fact that the human mind is finite. If all the parts of the real were one in the sense that none of them is in any degree independent, but that each depends for its nature and its very existence upon its relation to all the others, it would follow that there could be no genuine knowledge of a part without a knowledge of its relations to all the rest; and this would be equivalent to the statement that genuine human knowledge of *anything* is impossible. (See p. 290.) We have conceded that a moderate, compromising form of the singularistic theory might avoid this difficulty by introducing the idea of difference in degree of importance of the relations in which everything is still assumed to stand to everything else. Thus any given thing might be *defined* in terms of only its nearer relationships, and its more remote relationships might then be regarded as additional items of knowledge concerning it.

Our present point, however, goes deeper than this. It is no longer a question of whether singularism is logically possible,

assuming that there is some positive ground for accepting it; it is now a question of whether there really is any ground for the acceptance of any form of the singularistic doctrine—apart, of course, from mere liking or prejudice. In other words, we are about to throw the burden of proof upon the singularist. The world is empirically many; what reason can be given for saying that it is really One?

When this question is asked of the singularist, we find that the argument which he offers in support of his position always includes as one of its premises the assumption of the *internality* of relations. (See pp. 340 f.) Consider, for example, the argument offered by Royce. "Let us sum up, in a few words, our whole argument. There is, for us as we are, experience. Our thought undertakes the interpretation of this experience. Every intelligent interpretation of an experience involves, however, the appeal from this experienced fragment to some more organized whole of experience, in whose unity this fragment is conceived as finding its organic place. To talk of any reality which this fragmentary experience indicates, is to conceive this reality as the content of the more organized experience. To assert that there is any absolutely real fact indicated by our experience, is to regard this reality as presented to an absolutely organized experience, in which every fragment finds its place." [10] Here, especially in the last two sentences, the premise which we are now calling in question plainly appears. Nothing is real unless it is "presented." "The reality that we seek to know has always to be defined as that which either is or would be present to a sort of experience which we ideally define as an organized—that is, a united and transparently reasonable—experience. We have, in point of fact, no conception of reality capable of definition except this one." [11]

Now this is, of course, but Berkeley's *esse est percipi* over again. The singularistic argument depends upon the presupposition that *to be is to be known as being.* And this is a

[10] Royce, J., *et al.*, *The Conception of God*, 1897, p. 42.
[11] *Ibid.*, p. 30.

special case of the principle of the internality of relations. It is manifest that if the premise be granted, the singularistic conclusion necessarily follows. "If every reality has to exist," continues Royce, "just in so far as there is experience of its existence, then the determination of the world of experience to be this world and no other, the fact that reality contains no other facts, is, as the supposed final reality, itself the object of one experience, for which the fragmentariness of the finite world appears as a presented and absolute fact, beyond which no reality is to be viewed as even genuinely possible. For this final experience, the conception of any possible experience beyond is known as an ungrounded conception, as an actual impossibility. But so, this final experience is by hypothesis forthwith defined as one, as all-inclusive." [12]

I have quoted so extensively from Royce (1) in order to be fair to the singularist hypothesis, and (2) in order to show how completely dependent it is upon the assumption that relations, and in particular the cognitive relation, are *internal.*[13] This premise, however, is denied by the realist. He holds that some relations, at least, and in particular the cognitive relation, are *external,* and in a sense, *accidental.* (See p. 293.) Thus a thing may enter into new relations, and still remain in all essential respects the self-same thing. From the standpoint of the realist there is, then, no reason for denying the common-sense belief that the world is many. Thus the realist becomes a pluralist, recognizing the existence of a multitude of reals.

Limits of Pluralism.—Thus an extreme singularistic position has no valid rational or factual support. It is important to remember, however, as already remarked, that extreme pluralism is not tenable either. It is impossible to deny that there is *order* in our world. In the first place, a large amount of inter-relatedness has already been discovered; and in the second place, it is necessary for science to postulate that there

[12] *Ibid.,* p. 43.

[13] This may not apply so clearly to the arguments of Spinoza and Hegel as it does to that of Royce.

is more inter-relatedness among the parts of the real than has as yet been discovered.

2. Determinism and Indeterminism

As in most cases of philosophical controversy, the conclusion of our inquiry into the rival merits of singularism and pluralism is an inglorious compromise. For both the pluralists and the singularists, it is a "peace without victory." We return to the position suggested in Chapter X. The inter-relatedness of the parts of the real is an indispensable postulate of descriptive and explanatory science; but, like the postulate of the trustworthiness of our cognitive processes, it is to be regarded as a *general* rather than as a universal proposition or set of propositions. Our cognitive processes sometimes lead us into error; but we assume that *for the most part* they are veridical. In the same way, there may be reals which stand in no relation at all to anything else; or, more probably, reals which are related to the rest of being in some ways but not in others. Thus, while we recognize that *resemblance in certain respects is an index of further resemblance,* we also recognize that this is true only for the most part, and not universally. Again, it is true only *for the most part,* and not unversally, that *what has been will be;* for along with a great deal of permanence, there is also in our universe a considerable amount of change. Finally, to anticipate the result of the discussion upon which we are now about to embark, the *principle of determinism,* the postulate that *every event has a cause,* need only be regarded as true *for the most part,* and not as a universal proposition.

Definitions.—Before going further with our discussion, it may be wise to stop and define our terms. Superficial students sometimes confuse "determinism" with "determinedness," or resoluteness. A man is said to be "determined," in the sense of resolute, if he is inclined to persist in whatever course of action he has entered upon. When this inclination is so marked as to be a source of inconvenience to his associates, the fellow is said to be stubborn or obstinate. This, however, is *not* the

sense in which the word "determinism" is used in philosophy. In philosophy an event is said to be "determined" if it is believed to have had a *cause;* and determinism, accordingly, is the theory that everything which takes place has a cause. The opposite theory is, of course, "indeterminism."

The determinist, then, maintains that all changes could be completely accounted for, if we knew enough, in terms of antecedent conditions. The indeterminist denies this, and contends that some events at least are uncaused and therefore could not be accounted for in terms of antecedent conditions, even by an omniscient intelligence.

For the sake of logical completeness we may distinguish two types, or perhaps we should say two degrees, of indeterminism. One of these might be called *thoroughgoing indeterminism;* the other might be called *partial indeterminism.* The former would be the theory that *nothing* is caused. The latter is the doctrine that, while some events are completely accounted for in terms of antecedent conditions, other events are not. Now it is hardly necessary to say that what I have called "thoroughgoing indeterminism" has never been defended. When the word *indeterminism* is employed without any adjective, we shall accordingly understand it to mean "partial indeterminism"; while we shall understand the word *determinism* to mean "thoroughgoing determinism."

Determinism and Fatalism.—The word "fatalism" is sometimes employed as a synonym of determinism. This, however, is an unfortunate usage. It would be more nearly correct to say that fatalism is an inconsistent mixture of determinism and indeterminism. For fatalism is the belief that certain outstanding events in the history of men and of nations were fixed or decreed beforehand, but that the series of occurrences leading up to these outstanding events were not fixed beforehand. Thus the fatalist thinks that the hour of a man's death and the outcome of a decisive battle are determined in advance; but less notable events he regards as undetermined, or perhaps as determined in some other way. It is said that soldiers and

sailors, who are exposed to vicissitudes against which individual prudence counts for very little, are likely to adopt a fatalistic attitude. When a man is killed, they reason, it is evidence that "his time has come." No one can be hit by rifle bullets or drowned in the sea until his time has come.

The idea of man as the sport and plaything of the fates was a favorite subject of the Greek tragic poets. A famous example is the story of Oedipus. The fates had decreed that Laius, king of Thebes, should be slain by his own offspring. This information the king received from an oracle prior to the birth of his son Oedipus. In order, if possible, to prevent the impending evil, the king delivered the babe to one of his shepherds, whom he charged to expose the child upon the hills and allow it to perish. It chanced, however, that the herdsmen of Polybus, the king of Corinth, found the infant and took him to Peribæa their queen. She, being childless, took pity upon the babe and brought him up—in complete ignorance, of course, of his royal lineage—as her own child.

After Oedipus had grown to young manhood, having become curious about his origin and being unable to get any satisfaction from his foster mother, he consulted the oracle of Delphi. He was directed to shun his native country; for, the oracle informed him, it was decreed by the fates that he would murder his father and become the husband of his own mother. Unwilling to return to Corinth, where, as he supposed, such horrid crimes awaited him, Oedipus remained in the vicinity of Delphi. One day as the youth was traveling along the highway Laius, the king of Thebes, came toward him in a chariot with but two or three attendants. The attendants roughly ordered Oedipus to stand aside. Angered by their rudeness, the high-spirited youth drew his bow and shooting a random arrow at the chariot slew the king.

Thus without knowing it Oedipus had fulfilled the first part of the decree of the fates. A little later, after various vicissitudes, he came to Thebes, where because of his success in solving the riddle of the Sphinx he was made king, and soon after

became the husband of the widowed queen, his mother. The story continues with an account of the plagues visited upon the state of Thebes as a punishment for the crimes which Oedipus, by decree of the fates, had ignorantly committed.

Determinism and Freedom.—Fatalism is, however, as we have said, an incongruous mixture of determinism and indeterminism. According to fatalism, a man may be supposed to know his fate and to struggle against it. But what the fates have decreed will surely come to pass. Struggle as one may, what has been determined will be fulfilled. Indeed the very measures which are taken to forestall the dreaded event become, as in the story of Oedipus, the means of bringing it to pass. Thus it is fated that a man shall die at a given hour. When the time arrives, he does not go to the battlefield or to his accustomed place of business, but stays in his own house —and while thus taking care of his precious life falls down the stairs and breaks his neck! A consistent determinism, on the other hand, makes no distinction between events which are important and events which are unimportant. The latter are just as necessary, just as much a part of the pre-established scheme of things, as the former. According to the determinist, a mind which had a complete knowledge of the past and present of the universe could predict the future down to the smallest detail.

It may be objected, however, that such a view of things amounts to a denial of human freedom. And in many discussions, the question is stated as an issue between determinism and "free will." Wholly apart from the fact that this way of stating the issue seems to imply the exploded "faculty theory" of the will, the formulation is unsatisfactory. For "freedom" is an ambiguous term. And we should add that a man's freedom is a matter of degree. We should ordinarily regard a man as free in so far as nothing *outside the man* hinders him from doing as he wishes. In this sense of the term, some men are freer than others; and it is probable that there is no one who is *absolutely* free. The slave is not free, because he must respond to the beck and call of his master whether he wishes to do so or

not. The "free and equal" citizen of a modern democracy is only partly free, because his "personal liberty" is restricted by a multitude of regulations and prohibitions. Even Robinson Crusoe on his lonely island was not wholly free, because he was prevented by barriers which he could not surmount from returning at will to his native England.

Those who contrast determinism with freedom seem, however, to have in mind a conception of freedom more radical than the ability to do what one wishes to do. They seem to imply that a man who was perfectly free would be able not simply to do as he might wish, but that his wishing and choosing would themselves be undetermined. In other words, it is not enough for these advocates of freedom that a man be free from external control; they demand that he shall, as it were, be *free from himself,* from the effects of his own *past.* And this suggests a very pretty question: Is my present act of choosing an undetermined event, or is it determined by my heredity, my environment, and my past choices?

I presume that the vast majority of psychologists would say in answer to this question that for the most part, at least, one's present choices are thus determined. They would hold that my present act of choosing cannot be considered as an isolated event, as an occurrence which just happens; but that it is an expression of my present personality. They would hold, too, that what I have called my present personality is the resultant of a multitude of factors, some of which may be included under the term "heredity," others under the term "environment"; while past choices have a great deal to do in determining my present choice in any given case.

And this judgment of contemporary psychology is supported by the fact that if we really know a man we are usually able to predict what he will choose to do in any given situation.

We thus distinguish two conceptions of freedom. According to the one a man is called free if he is (relatively) independent of external control; according to the other he is not called free unless some, at least, of his choices are uncaused and therefore,

in principle and not simply in fact, unpredictable. Now it is only when the conception of freedom is understood in the latter more radical sense that it is incompatible with determinism. There is no real opposition between freedom, in the sense of independence of external control, and a thoroughgoing determinism. One may hold without inconsistency that all of a man's acts—his feelings, emotions, intentions, volitions, motives, etc., as well as his overt behavior—are completely accounted for by antecedent conditions, and also that the man is free. Only, if the man is free, the antecedent conditions of his behavior must be *within the man himself*. Thus freedom may be defined as determination from within, or "self-determination."

Ethical Objections to Determinism.—In this way, we may effect a reconciliation between the conceptions of determinism and freedom. Many persons, however, do not find our idea of freedom as self-determination satisfactory. Instead, they insist upon the recognition of the more radical type of freedom, which as we saw in the preceding paragraph, implies indeterminism. This is the position, in particular, of William James in *The Pluralistic Universe* and elsewhere.

Various objections to determinism have no doubt occurred to the reader. Some of these, I think, are not well taken; while others hold against singularism rather than against determinism. For determinism, as we shall see below, need not be singularistic.

(a) It is contended by many that on the determinist hypothesis *punishment* would be unjust. The wrong act is assumed to be necessary. It flows, let us say, from the character and circumstances of the agent, and is thus ultimately referable to his original hereditary endowment, or lack of endowment, and to the environment in which he has been placed. To this the determinist replies that punishment has value only as a system of devices which form a part of the agent's environment; and that, unless punishment is believed in some way to determine the future behavior of the one who is punished, it has no justification whatsoever.

To make use of an illustration suggested by Professor Everett,[14] let us suppose the case of a small boy with a very hot temper which very frequently gets him into trouble. This boy, grown to manhood, becomes the father of a boy who also has a very hot temper. The father has every reason to believe that the child's unfortunate disposition is inherited. Does the father, knowing all this, have a right to punish his son for manifestations of temper? Our first impulse is to say, "No; since the child has inherited his unfortunate temper, he is not to blame for it, and therefore ought not to be punished."

The determinist, however, takes the position, I believe rightly, that it is not only the right but also the duty of the parent, in such a case, to punish his child. He should punish him in order to help him overcome his hasty temper. Since the child has an unfortunate heredity, his environment should be so modified as to determine his conduct in a salutary direction.[15] Otherwise, the determinist contends, punishment would be nothing but *revenge*. For if punishment has no effect upon conduct, what purpose can it have, other than as an outlet for our ill-feeling against the transgressor?

(b) It is often argued that the hypothesis of indeterminism is required to safeguard the idea of moral responsibility. But if we inquire more closely we shall find that exactly the contrary is the case. Moral responsibility really implies determinism. For if one's conduct bore no necessary relation to his character, it would not in any significant sense be *his* conduct at all. Indeed, it is only when we have reason to believe that a man's behavior is the expression of his character that we regard him as responsible for it. A fever patient is not responsible for what he says or does in his delirium, because, we say, he is "not himself." In the same way, an act which merely takes place, so to speak, "on the premises," without being determined by the character of the agent, would not be an act for which

[14] *Moral Values*, 1918, p. 372.

[15] Of course if punishment would not produce this result, the child should not be punished. In that case our illustration would be unfortunate; but the general principle which it is meant to illustrate would not be affected.

the so-called agent could rightly be held responsible. It would not be his act. As the little boy protested, when reproved for whistling in public, "*I* didn't do it, it just whistled"; so we should have to say of the conduct of any so-called agent, in so far as it is believed to be undetermined, "*He* didn't really do it, it just occurred."

Indeed, if indeterminism is demanded on ethical grounds, we may well inquire whether our ideas of moral training and of character do not logically require the determinist rather than the indeterminist hypothesis. For what is moral training if it is not an attempt *to determine* the future behavior of those who are subjected to it? And what is character if it is not something within the agent himself which *determines* how he will act in particular situations? "As the twig is bent, the tree is inclined": if a child has been well trained, we believe that he will acquit himself well in after-life. And if a man has a good character, we know what to expect of him; we feel that we can safely predict that he will do the right thing in spite of such temptations as may entice him to an anti-social mode of conduct.

We conclude then that, instead of determinism being incompatible with punishment, moral responsibility, moral training, and character, it is really presupposed by them; and that they are all significant *only in the degree that determinism is true.*

Is Determinism Singularistic or Pluralistic?—It is manifest that the believer in the singularistic view of the world is also a determinist. The singularist holds that everything which is, is a necessary part of the Whole. Thus Spinoza regards everything as a logical implicate of the one fundamental substance, which he calls "God." Pluralism, on the other hand, as we saw in the preceding section, contends for the partial independence of the various entities which compose the universe. They are independent of each other in the sense that some can be changed without necessarily producing a change in all the others.

The pluralist need not, however, be an indeterminist. He

might concede that everything has a cause, that every event is determined; but recognize the existence of a multitude of relatively independent streams or strands of determination. Singularism regards everything as a function (in the mathematical sense) of everything else, and therefore of the Whole. For the singularist, the *cause* of any given event is nothing less than the state of the entire universe at the time when it occurred. For the pluralist, the cause of an event is a relatively small part of the universe. The pluralist, in so far as he is a determinist, would hold that every event has a cause; but he would deny that *everything* is to be included in the cause of any given event.

It is manifest then, that it is only the pluralistic type of determinism which is compatible with freedom, ethical responsibility, etc. For freedom, in the sense of self-determination, implies the independence of the individual self. A self which is but a part of the Absolute, or whose behavior results necessarily from the nature of the Whole of reality, would not be free in any significant sense of the term. Neither would such a self be morally responsible. For, while it is necessary that the behavior of a given agent shall be determined in order that it may be *his* behavior, it is also necessary that it be *determined from within;* marionettes are not morally responsible for what they "do."

The Logical Possibility of Partial Indeterminism.— There is, then, no really serious ethical objection to the pluralistic form of determinism. We must, however, recognize the logical possibility of *partial indeterminism* also. Pluralistic determinism (if we may picture time as a downward flow) may be said to recognize a thoroughgoing determination of events in the *vertical* direction, while insisting upon a greater or less amount of indeterminism in the horizontal directions. Indeterminism, on the other hand, would recognize a lack of causal connection in the vertical as well as in the horizontal directions. Or, to drop the figure of speech, while pluralistic determinism would insist upon a causal relation of any given event with

certain of its predecessors—thus regarding every event as belonging to *at least one causal series*—but would admit some lack of causal connection among contemporaries; partial *in*determinism would admit the lack, now and then, of causal connection between temporal antecedents and consequents, as well as among contemporaries.

Now it must be admitted that it is logically possible that undetermined events may occur. Such events would, of course, be beyond the scope of scientific explanation. They would appear as surprises; they would be unpredictable even by an omniscient intelligence. Those who, like William James, have a sporting interest in novelty, will wish it to be true that undetermined events now and then occur. And there is no way of proving that they cannot or do not occur.

Science Postulates Determinism.—If science is to be possible, however, there must be some interconnection of events; and if science is to be significant, there must be a great deal of interconnection. Science, therefore, postulates determinism. It is important to remember, however, that science does not need to postulate the principle that every event has a cause, as a principle that has no exceptions. While assuming that *for the most part* the cause-effect relation holds, science may admit the possibility of undetermined events now and then..

It may be asked, however, whether a world which is supposed to include undetermined events would be intelligible. The human mind craves unity; and singularistic determinism, with its doctrine of the mutual implication of all things, would give us the most perfect unity and intelligibility. Would indeterminism destroy the intelligibility of the world? We must answer, I think, that thoroughgoing indeterminism would make the world unintelligible. Intelligibility, however, is a matter of degrees; and either partial indeterminism or pluralistic determinism or a compromise between the two, *if assumed to be true,* would give us the precise degree and amount of intelligibility to which we are entitled. As long as A can be shown to be a function of B, and M can be shown to be a function of N,

etc., etc., inference is possible, even if A, B, etc., on the one hand, must be regarded as independent of M, N, etc., on the other.

3. Teleology and Mechanism

Whether we decide for partial indeterminism or pluralistic determinism, or for a compromise between the two, we must recognize a greater or less amount of determination. Now there are two general types of theory about the nature of this determination of events. These are (1) the *teleological* theory of determination, and (2) the *mechanistic* theory of determination.

Teleology.—We have already defined teleology as *the operation of purpose in the production of events.* (See Chap. III, p. 55.) The term is also used as a name for the *theory* that purpose is thus operative. For our present point of view, *mechanism* may be defined roughly as the absence or the opposite of teleology. Thus a mechanistic order is characterized by the absence of purposive control.

We need not repeat our arguments for and against the conception of cosmic teleology. (See Chap. III.) It may be helpful, however, to summarize the results of that discussion. By "cosmic teleology" we meant purposive control, not merely of events and processes *within* the cosmos, but of the evolution of the cosmos as a whole, or at least, of such cosmic processes as are admittedly beyond human control. Our conclusion was that cosmic teleology is *unproved.*

On the other hand, we may add here that cosmic teleology has not been *dis*proved either. It is possible to argue that there may be an all-controlling purpose of which we finite human beings are ignorant. The universe *may* be directed toward the attainment of goals which are wholly foreign to our knowledge and to our interest. It *may* be that the happiness and well-being of man are of negligible importance in comparison with the attainment of the goals toward which cosmic endeavor tends.

Speculations of this kind have appealed to many people; but

to my mind they are singularly futile and barren. On this hypothesis, human purposes would bear the same relation to cosmic purpose which the purposiveness, let us say, of a hungry spider bears to human purposiveness. Just as the spider, if he happen to be a philosopher, may perchance find comfort in the thought that the destruction of his new web is incidental to the accomplishment of some wider purpose which he is unable to understand; so we, it is said, are to find consolation in the reflection that our sorrows and frustrations *may* be contributory to the achievement of some unimaginable cosmic good. Thus, for example, a destructive earthquake might be incidental to a cosmic housecleaning!

Any teleological hypothesis, however, which appeals to *purposes that have no human interest and transcend human understanding* seems to me to be unworthy of serious consideration. A hypothesis which, whether it be true or false, can in the nature of the case be neither proved nor disproved need not detain us further.

Predestination.—A variety of the conception of cosmic teleology which has been very important historically is the doctrine of *predestination.* Students of philosophy have been known to confuse the words "theology" and "teleology." This confusion is not quite so reprehensible as most of the blunders made by careless students; for in predestination we have a teleology which is also a theology. The doctrine of predestination is, in brief, a form of singularistic determinism in which all events are assumed to be produced by the sovereign will of God.

Many of the popular objections to predestination are due to a confusion of predestination with fatalism. Thus the common objection that, if a man is predestinated to salvation, it is unnecessary for him to lead a righteous life, is satisfactorily answered by the predestinarian who reminds us that one who is predestinated to salvation is also predestinated to holiness. Similarly the famous paradox that if a sick man is to die it is useless to call the physician, while if he is to recover it is

unnecessary, is resolved by pointing out that the calling of the physician, or the failure to call him, is itself an event which is included in the divine decree. Both of these difficulties result from a failure to understand that, according to the predestinarian, *all* and not only *some* events are determined. In any given case, not only the *end* but all the *means* leading up to that end are included in the divine plan.

There are, however, more serious difficulties, which the predestinarian is not able to meet so easily. These result from the presence of evil in the world. If, as the predestinarian maintains, all events are included in the divine decree, then acts of man which we call sinful or wicked must be predestinated. For example, a murder must have been predestinated. Is it therefore in accordance with the will of God that murder and other crimes should be committed?

In the writings of John Calvin, I find two suggestions toward the solution of this difficulty. (1) He distinguishes between the *preceptive* and the *decretive* will of God. The former may forbid what the latter has predestinated. Thus God enjoins that brethren love one another, that sons show proper respect for their father, that all speak the truth. The sale of Joseph into Egypt was therefore contrary to the preceptive will of God, and as such was a sinful and wicked transaction. Nevertheless it was in conformity with the decretive will of God, for it was a step in bringing to pass what He had planned for the family of Jacob.

(2) Following Augustine, Calvin also makes a distinction between the evil deed considered as a fulfilment of the *intention of man* and the same deed considered as a fulfilment of the *will of God*. Though the former is bad, the latter is always good. For example, suppose that a son kills his father in order to inherit the property. Although the act was decreed by the secret will of God, the slayer is guilty of murder; for he *intended*, not to fulfil the decree, of which he was ignorant, but to secure the property for himself.[16]

[16] Calvin, John, *Institutes*, I, 18.

The reasoning, however, is too ingenious. It is hard to see how the distinction between the preceptive and the decretive will of God can be more than a verbal shift. And in distinguishing between God's will and man's intention, Calvin overlooks the fact that the intentions as well as the actions of men are *events,* and must therefore be included in the divine decree; for otherwise we should have to admit the occurrence of events which are contrary to God's will, and the divine sovereignty would be limited. The existence of evil, then, constitutes a serious objection to any theory which maintains the unlimited sovereignty of the divine will. (See Chap. XIV, p. 413.)

Immanent Teleology.—The doctrine of predestination, as it is usually interpreted, places the source of the determination above and outside of the system of events. In technical theological terminology, God is said to be *transcendent.* As we saw, however, in Chapter II (p. 30), one result of the extension of the idea of natural law has been to cause theologians to think of God as *immanent,* that is to say, as dwelling in the world. Thus we pass from the idea of an external providential control of the world to the idea of immanent purposiveness. The world is found to be purposive in the sense that it exhibits certain trends or tendencies. Thus the world is said by some thinkers to be "biocentric." And many of us like to believe that there is a cosmic drift or urge in the direction of *values.*

Conscious and Unconscious Purposiveness.—The difficulty with immanent teleology, however, is that it tends to interpret the notion of *purpose* in such a vague fashion that it retains but little similarity to what common sense has meant by the term. "The evidence is pretty strong," says Professor Patrick,[17] "that the world is purposive in the sense of exhibiting order, pattern, 'design,' organization, structure, value, ends; and certainly the most natural, if not the most logical, explanation of this fact is the presence of mind immanent in the world. That the action of the 'divine mind' is ideational, volitional, actuated by desire, like the finite human mind, is not

[17] *Introduction to Philosophy,* 1924, p. 160.

necessarily implied in a purposive world. It is not even implied that such a mind is conscious, if by consciousness we mean that awareness and togetherness of thought which characterizes finite minds."

One can't help asking, however, if immanent mind is so unlike what we have usually understood by mind, why we should keep on calling it "mind"; and why, if immanent purpose is so unlike our ordinary, everyday purposes, we should continue to speak of it as "purpose." It might be suggested, indeed, that any tendency whatsoever, as for example the needle's pointing to the pole, water's flowing toward the sea, or nature's "abhorrence" of a vacuum, may be regarded as a purpose, or as a manifestation of cosmic striving.[18]

Not very different from this idea of purpose as a mere drift or tendency is Bergson's doctrine of the *élan vital*. This is a sort of mysterious cosmic urge which is assumed to be the cause of new biological species and in general of such new entities or values as appear in the course of "creative evolution."

Now if all that we are to understand by the word "purpose" is some tendency or cosmic drift of this kind, we may very well admit that there is cosmic purpose; but if this is all that has been meant, the dispute between the mechanist and the teleologist has been of very little importance. And it seems clear that the attractiveness and apparent significance of the conception of unconscious purposiveness depend upon an almost irresistible tendency to slip over every now and then from the thought of a purpose which is unconscious to that of a purpose which is intelligent and consciously beneficent.

If by teleology we mean design, and if design is a "seeing force which runs things," then the issue between teleology and mechanism has some human importance; but if all that the teleologist contends for is the recognition of a design which

[18] What was referred to above as a "cosmic drift or urge in the direction of values" may be described from a more critical point of view as *a natural selection of the good*, in the sense of the coöperative. (See pp. 370 ff.)

was never designed, a plan which was never planned, a purpose which was never consciously intended, a striving after ends which have never been envisaged—if this is all that is meant by teleology, it is hard to see any very significant respect in which it differs from mechanism. As James remarks,[19] "The mere word 'design' by itself has no consequences and explains nothing. It is the barrenest of principles. . . . *No matter what* nature may have produced or may be producing, the means must necessarily have been adequate, must have been *fitted to that production*. The argument from fitness to design would consequently always apply, whatever were the product's character. The recent Mont-Pelée eruption, for example, required all previous history to produce that exact combination of ruined houses, human and animal corpses, sunken ships, volcanic ashes, etc., in just that one hideous configuration of positions. . . . We can always say, therefore, in any conceivable world, of any conceivable character, that the whole cosmic machinery *may* have been designed to produce it. Pragmatically, then, the word 'design' is a blank cartridge. It carries no consequences, it does no execution. *What* design? and *what* designer? are the only serious questions, and the study of facts is the only way of getting even approximate answers."

Final and Efficient Causation.—Teleology is sometimes defined as the doctrine of *final causes*. The final cause of an event, we said in Chap. III (p. 58), is *that for the sake of which the event takes place;* while a cause, in our ordinary sense, is known as the "efficient cause." Defenders of teleology have not, however, adhered as closely as one might wish to a consistent conception of final cause, and the definition just repeated is not very precise.

"In the conception of final cause," writes Mr. G. E. Moore,[20] "are mingled three different senses:

"(*a*) that for the sake of which a thing ought to exist, *i.e.*

[19] *Pragmatism*, 1907, p. 113.

[20] *Dictionary of Philosophy and Psychology*, 1906, article on "Cause and Effect."

either the good qualities which the thing itself possesses, or some other good thing of which it is the efficient cause;

"(*b*) that for the sake of which a given thing was produced by some intelligence;

"(*c*) the design, considered as a mental fact, which was the efficient cause of its production."

"It is only the failure to distinguish (*c*) from (*b*)," continues Mr. Moore, "which explains why the final cause was thought to be a cause at all. . . . On the other hand, both Plato and Aristotle do generally regard that which is desired, and not our desire of it, as both final and efficient cause of the actions which lead to its attainment."

If, now, when the teleologist speaks of the *final cause* he understands the term in sense (*c*) as "the design, considered as mental fact" which produces a given event, he is employing a conception which is important, if true. It, however, introduces nothing which is in principle different from the ideas which we have already discussed. On the other hand, if *final cause* is to be understood in senses (*a*) or (*b*), it becomes necessary to think of a cause as *temporally subsequent* to its effect; for in many cases that for the sake of which an event occurs comes *after* the given event.

"Peer as deeply and fixedly as you will into the abysses of your own being, you shall always find therein that it is all and only the Future that determines and in a way creates the Present. At every instant the Past crumbles into nothingness under our feet and we flee from it as from a levee sinking into the Mississippi, while the eternal Future, like the eternal Feminine, draws us upward and on. . . . We may say, then, that it is To-morrow and not Yesterday that makes To-day what it is. In itself it is no more and no less plausible that the Future than that the Past should determine the Present; but the undeniable fact is that the determinant is the Future and not the Past." [21]

[21] Smith, W. B., *The Monist*, Vol. 23, p. 33. Quoted by Patrick, G. T. W., *Introduction to Philosophy*, 1924, p. 163.

Now, as we pointed out in Chapter III (p. 59), there is no logical absurdity in the notion of a cause which is temporally subsequent to its effect. On the other hand, if we do not allow ourselves to be misled by the figure of speech involved in such terms as "push," "pull," *"vis a tergo,"* "attractive force," etc.,[22] there is no reason why this notion should be especially edifying. If two states of affairs are so inter-related that either may be taken as the sign of the other, then whichever of the two is regarded as the sign will be called *the cause,* and the other will be called *the effect.* Now it is obvious that the one which serves as sign may in some cases be earlier, in some cases later, and in some cases contemporaneous with, that which it signifies. If the two states of affairs are successive, it is wholly a matter of convenience whether we reason backward or forward in time. In other words, it is wholly a matter of convenience whether we think in terms of final or of efficient causation.

For example, given a knowledge of the motions of the heavenly bodies in the nineteenth century, the astronomer is able to *infer* with a considerable degree of accuracy the motions which will take place in the twenty-first century; and by calculating backward, he is also able to infer the motions which took place in the seventeenth century.

Now the teleologist would no doubt say that the celestial phenomena of the nineteenth century—or such of them, at least, as seem to him to be good—are the *final causes* of the celestial phenomena of earlier centuries; and, if all he means by this is that, the later phenomena being *given,* the earlier can be *inferred,* we need not quarrel with his mode of statement. Only, as I remarked above, there is no reason why this way of speaking should be regarded as especially edifying. Indeed, if this is all that is meant by teleology, it is manifest that it differs in no important respect from the theory of mechanism.

Mechanism.—The traditional dispute between the teleologists and the mechanists is found, then, to be very largely an affair of words and definitions. As the issue is sometimes stated,

[22] Cf. Patrick, *ibid.,* pp. 164 f.

the two theories would seem to be but two sides of the same shield. There are, however, several points of view which seem to me to be both logically distinguishable and important. Leaving out of account, for the moment, the purposes of beings such as animals, men, or angels, whose radius of control is admitted to be relatively limited; and putting aside as unimportant, and likely to obscure the issue, the conceptions of unconscious purposiveness and final causes, we may ask whether the cosmos, in its wider aspects, is dominated by purpose.

An affirmative answer to this question gives us the point of view which I have called the theory of cosmic teleology. The opposing theory is mechanism. (It is convenient to employ the terms teleology and mechanism to denote both *types of order* and *theories* about the type of order which actually obtains in the cosmos.)

We may next distinguish a less and a more radical form of cosmic teleology by raising the question whether the dominating purpose is or is not assumed *to make use of mechanism* in seeking its fulfilment. If this question is answered in the negative, that is to say, if it is assumed that the cosmic purpose achieves each of its ends directly, we have a conception which may be called *thoroughgoing teleology*. If it be assumed, however, that the cosmic purpose makes use of mechanism, we may inquire whether the mechanism has been produced by purpose, or whether the mechanical order is supposed to be coeval or co-eternal with the teleological order. The former of these theories I shall call *mechanistic teleology,* and the latter either *dualistic teleology* or *dualistic mechanism.*

On the other hand, if the mechanistic theory be adopted, that is to say, if we assume that cosmic processes are *not* controlled by purpose, we shall then have to choose between a *thoroughgoing mechanism,* which denies that purpose has any rôle whatsoever, and a view which regards purpose as efficient but temporally subsequent to and produced by the mechanism. This last theory we shall call *emergent mechanism.*

We thus have five possible theories:

(*a*) Thoroughgoing teleology: purpose makes no use of mechanism.

(*b*) Mechanistic teleology: purpose uses mechanism, which, however has been called into being by purpose.

(*c*) Dualistic mechanism: purpose uses mechanism, which is coeval with the purposive order.

(*d*) Thoroughgoing mechanism: purpose has no part whatsoever in determining the occurrence of events.

(*e*) Emergent mechanism: purpose is efficient in determining the occurrence of events; but it is later in time than mechanism, and is produced by it.

Conclusion.—A few remarks may be made concerning these five theories. In the first place, it must be recognized that, as long as we retain the point of view of the sciences and decline to have our thinking determined by external authority, any form of cosmic teleology must be regarded as an unproved hypothesis. This remark applies to (*c*), as well as to (*a*) and (*b*); for, as we have said, it might be called *dualistic teleology* just as appropriately as dualistic mechanism. Any theory which holds that the cosmos is consciously directed toward some end or goal ought to be able to give some account of the end, and also some inkling of the evidence upon which we should rely for our belief that the end will be realized or the goal attained. Thus far no plausible description of the alleged cosmic goal has been given; and—while there seem to be more or less important drifts or tendencies within the cosmos—no satisfactory evidence of progress toward a cosmic goal has been presented.

In the second place, if we adopt either hypothesis (*a*) or hypothesis (*b*), it is impossible to find a satisfactory solution of the *problem of evil*. According to the former of these varieties of cosmic teleology, the cosmic purpose is supposed to determine each event which takes place. Now, as we saw in our discussion of predestination, there is no escape, on this hypothesis, from the conclusion that the cosmic purpose is responsible for the evil of the world; and therefore if we assume that the dominating purpose is *good*, we must conclude that so-called evil

is not evil after all. According to our second form of cosmic teleology, it is possible to postpone the difficulty by introducing the conception of "secondary causes," to which the evil of the world may then be referred. For according to this view the cosmic purpose works through mechanism, somewhat as a man operates a machine. Thus some forms of evil, at least, may be referred to secondary causes, that is to say, to the mechanism. When we recall, however, that cosmic purpose is supposed, on this hypothesis, to be responsible for the mechanism, we see at once that the conception of secondary causes affords no satisfactory explanation of the fact of evil. In the case of dualistic mechanism this objection does not hold, for the mechanism is not produced by the cosmic purpose; and consequently it is logically possible to refer to it anything in the world of which we do not approve. Thus, according to a very ancient tradition, the evil of the world is ascribed to the refractoriness of matter.

Coming now to hypotheses (*d*) and (*e*), our two varieties of mechanism, there seems to be no good reason for the adoption of what I have called thoroughgoing mechanism; for it involves an epiphenomenalist view of the relation of mind to body, and this we have found to be an untenable position. (See Chap. VII, p. 206.) Indeed, entirely too much ingenuity is required in the effort to explain away the multitude of cases in which purpose at least *seems* to have a part in the determination of events.

We conclude, then, that emergent mechanism is the hypothesis which accords best with the facts.[23] According to this theory, teleology is a fact; but the kind and amount of teleology which actually obtains in the cosmos is a question for empirical determination. This view encourages the hope that from age to age the rôle of purpose may become greater and greater.

Emergent mechanism agrees, in principle, with the so-called "theory of levels," or of emergent evolution; and it implies a

[23] It should be borne in mind that according to this view it is not the *mechanism* which emerges, but rather that the mechanism is the occasion for the emergence of purpose. (See p. 326 n.)

view of the mind-body relation which is equivalent to our "Interactionism (c)." It also harmonizes with what we found to be the most probable conceptions of the origin of life, of biological variations or mutations, and of the individual self. (See Chap. VII.)

It differs from thoroughgoing mechanism in that it recognizes the rôle of purpose; while it differs from thoroughgoing teleology, mechanistic teleology, and dualistic mechanism in regarding the teleological order as a product of the mechanism. Thus mechanism would be chronologically prior to teleology; but the mechanistic universe, having brought forth purpose, like Humpty Dumpty after his famous fall, would never be as it was again. Or, if it would be going too far to assert that the purely mechanical order could never be re-established after this hypothetical lapse into purposiveness, it might still be proper to point out that, according to the hypothesis which we are now considering, the purposive order, although emergent rather than substantial, is able to react upon the mechanical order from which it emerges, and in many important ways to alter and control it.

It would, however, be misleading to say without qualification that the theory which we have called emergent mechanism gives us a satisfactory "explanation" of the universe. To be sure, since all satisfactions are relative, the claim may be admitted, if all that is meant by it is the assertion that emergent mechanism is more satisfactory, or less unsatisfactory, than any of its rival theories. It would, perhaps, be more accurate to say that emergent mechanism, as a theory of the origin of purpose, recognizes obvious limits to the possibility of explanation, than to say that it "explains"; for when we suggest that mechanism is able to produce purpose, our meaning is not that purpose is only a more complicated mechanism, or that by some very ingenious process of reasoning it can be *reduced* to, or *deduced* from, mechanism, but rather that purpose regularly *emerges on the occasion of* certain configurations which from time to time obtain in the mechanical order.

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CHAPTER XIII

THE REAL AND THE IDEAL

Among the facts which are vouched for by experience but cannot be reduced to, or completely explained in terms of, thoroughgoing mechanism, are *values* and our human *interest* in values. Timorous defenders of the validity of ideals are wont to tremble lest "behaviorism" and other variants of the "materialistic" and "mechanistic" points of view destroy values and render all our ideals illusory. These well-meaning steadiers of the ark seem to have forgotten that a true theory makes room for *all* the facts. For, granting our loyalty to ideals to be a fact, the mechanistic hypothesis must either be pronounced false, or else it must be so modified or interpreted—whether by the admission of the conception of "emergence" or in some other way —as to make room for this fact.

The mechanistic doctrine of man is often put, especially for purposes of controversy, in this way: *Men are nothing but machines.* But it is manifest that the same doctrine may be expressed thus: *All that a man is, a machine of such and such a type is too.*

Now if the latter form of statement be chosen—as it well may be, seeing that the two forms of statement mean the same thing—a machine-theory of man would not be so dreadful, after all. For if it be true that we are machines, machines must then be capable of more than has commonly been supposed. If men are indeed machines, Luther and St. Francis, Moses and Gautama and Jesus, all the saints and heroes of the human race, were machines, and all their deeds and thoughts were the deeds and thoughts of machines.[1]

[1] See an article by the writer on "Science as Symbol and as Description," *The Journal of Philosophy,* Vol. XXIII, p. 324.

In short, no mechanistic theory can degrade man; its effect would rather be to exalt the worth of mechanism. Man *is* what he is; and no theory of man can be accepted as true unless it recognizes the existence of values and ideals as a *fact,* and unless it succeeds in somehow making room for this fact. *Emergent mechanism,* as we saw in the preceding chapter, fulfils this requirement; it admits the reality of human purposiveness, and encourages the hope that man may, to a greater and ever greater extent, refashion his world in accordance with patterns and standards of his own choosing.

1. The Adjustment of Conflicting Purposes

This remaking of reality is delayed, however, by a conflict of ideals and a clashing of purposes. The refashioners of the mechanistic order are at variance with each other. Not only is man at war with a hostile or indifferent world of animate and inanimate being, but he is at war with himself. Among the millions of selves which make up the human family, and also within each "individual" self, there is a tragic competition of interests; and if purpose is to dominate the cosmos, it is imperative that we find some principle or principles in accordance with which human purposes may be harmonized with each other and with all such needs and interests as ought to be taken into account.

Symbiosis.—It is manifest that any principle which is proposed for the harmonization of competing interests must be based upon, or must at least be in agreement with, the accredited findings of biology. And it may seem unlikely, at first thought, that biology, with its doctrine of the "struggle for existence," should give much encouragement to the idea of a coöperative cosmos.

The conception of the struggle for existence is, however, a much-misunderstood doctrine. When we look into the matter more closely, the "struggle" is found to be a competition between coöperative groups at least as much as it is a contest between detached individuals. Indeed, we should not be far

wrong if we were to describe the so-called struggle for existence as a *competition in coöperation.*

One of the most striking forms of coöperation reported by the biologists is that which is known technically as "symbiosis," or "symbiotism." This is the name applied to the mutually beneficial partnership, or living-together of dissimilar organisms. As we shall see, these terms are also used more loosely to denote any kind of coöperation whatsoever among living forms. The typical case of symbiosis is that of the lichens, which are found to be, in reality, double plants. Before the invention of the microscope, the true nature of the lichen was unsuspected; but it has been found possible to separate the two constituents, to grow each separately, and then to recombine them in such a way as to produce the lichen as it ordinarily exists. One of the partners in this strange alliance is a fungus, and the other is an alga. It is believed that each of these contributes something toward the life of the other. "In the simpler forms," says Wallin,[2] "the reproduction of the two symbionts is independent. It is necessary for the offspring of the two symbionts to find each other, and again join in the production of a daughter lichen. . . . In the higher groups of lichens, a reproductive organ . . . is formed. Both symbionts supply materials in the formation of the reproductive elements. In these higher lichens the symbiosis has become *absolute,* and reproduction is no longer independent. . . . There is no question regarding symbiosis in the lichens, as the symbionts are readily distinguishable. Here is an example of an entire group of organisms whose origin unquestionably *depended upon the establishment of a symbiotic relationship.*"

Another interesting example of symbiosis is afforded by the case of the heather, which, we are told, does not thrive unless its roots are infected with a certain fungus. Somewhat similar is the partnership between various plants—such, for example, as the clovers or the legumes—and certain species of nitrogen-fixing bacteria. The bacteria provide nitrogen for the plant;

[2] Wallin, I. E., *Symbionticism and the Origin of Species,* 1927, p. 95.

and the plant, in turn, provides carbohydrates for the sustenance of the bacteria.[3]

In all these cases, the relation may at first have been one of parasitism; but through mutual adaptation it has become, in greater or less degree, beneficial to the host as well as to the parasite. Indeed, no sharp line can be drawn between parasitism and symbiosis; for there are all kinds and degrees of interrelation, ranging from such obviously one-sided relationships as that between the tapeworm and man, to cases of perfect or almost perfect symbiosis, such as those referred to in the previous paragraphs.

There are many other cases of obvious interdependence, which by a slight extension of the meaning of the term may also be included under the head of symbiosis. Thus everybody knows that the bees, while flying from flower to flower in pursuit of honey, carry pollen from one to the other and thus insure their cross-fertilization. In this same connection we might speak of the analogous relation of certain species of ants to their aphids. Indeed, we might go further and include here the division of labor in human societies as well as the coöperative activities of social insects, such as ants, bees, and wasps.

Co-Adaptation a Principle of Nature.—In this very general meaning of the term, symbiosis or symbiotism is a well-nigh universal phenomenon. Man depends upon his domesticated animals, and these depend upon man; the bees depend upon the clover, and the clover depends upon the bees; in human society every trade or profession depends upon all the rest. Not only is it true that each individual or each species is adapted to the environment in which it lives, but various organisms are so *co-adapted* that each is better off by reason of the existence of the others.

"Ethics in Terms of Symbiotic Trends."—Considerations such as these have suggested the possibility of finding a rational foundation for ethics in a consideration of the "symbiotic trends" which appear in various types of human organization.

[3] See Thomson, J. A., *The Outline of Science*, 1922, pp. 611 and 653.

From this point of view the task of the student of ethics is to "discover which qualities of individuals have appeared in *necessary* relation with specific types of 'symbiotic trend,' and which have had to them a connection dependent upon conditions now past or upon accidental associations." [4] "The chief cultural or social forms may all be properly conceived," says Professor Hughes, "as forms of symbiotic relationship." "A society," he continues, "is good as it achieves success, and a higher measure of success, in personal adjustments through the establishment of symbiotic institutions and customs; and it may probably be shown that the several forms of symbiosis now current are not accidental but essential." [5]

The worth of a life would then be measured by its contribution to a wide symbiosis. A life-career would be considered *normal,* if the individual in question succeeded in effecting a satisfactory adjustment with his fellows and with the universe at large; while lives which exhibited "disbiotic" relationships would be condemned as examples of "biotic failure." [6]

Problems of Conduct.—Ethical problems, however, would still remain. For persons accused of "disbiotic relationships" —such, to employ Professor Hughes's examples, as the prostitute, the profiteer, the anarchist, the drunkard, the glutton, the mentally deranged person—might demand by what right they stand condemned. And in our reply we should have to find answers to questions such as these: Just why should symbiosis be preferred to parasitism? On what ground may one type of symbiotic relationship be pronounced ethically better than another? What fault can be found, for example, with the scion of dethroned royalty, who, firmly and honestly convinced of his superiority to the common herd of mankind, passes his time in idleness, supported by the labor of those whom he despises? What fault, indeed, can be found with the career of a burglar,

[4] See "Ethics in Terms of Symbiotic Trends," by Professor Percy Hughes, *The Philosophical Review,* Vol. XXXIV, p. 180.
[5] *The Journal of Philosophy,* Vol. XXIV, p. 151.
[6] *Ibid.,* p. 152.

a swindler, or a professional gambler, so long as he makes a good living and is able, as the saying is, "to get away with it"?

In the following section I shall suggest a set of postulates which seem to me to be necessary and sufficient to provide the foundation for a science of ethics. Such a science should give us a rational basis for the adjustment of conflicting purposes and interests, whether the conflict arises *within* a given individual or *between* various individuals or groups. In general, we shall postulate that the best "symbiosis" is an organization of interests and purposes such as secures a maximum of fulfilment with a minimum of frustration.

2. Postulates of Ethical Discussion

It might be possible to construct a body of doctrine—as in pure logic and mathematics—without any assumptions whatsoever concerning the nature or even the existence of reality *extra mentem;* but, as we saw in a previous chapter (Chap. X), if our science is to refer to objective reality, such assumptions must be made. In the same way, it might be possible to construct a system of *descriptive* and *explanatory* science without making any distinction between the "higher" and the "lower," the "better" and the "worse." Thus, whether we are describing the motions of the planets or the behavior of a human organism, we might wholly avoid any reference to relative values. We might content ourselves with bare statements of facts and descriptions of processes, without any judgments of approval or of disapproval.

As soon, however, as we express a *preference* for one type of behavior rather than another, and attempt to defend our preference by argument, we tacitly accept certain postulates of valuation; and the following are suggested as sufficient to provide a logical basis for ethical discussion.

(a) The Moral Quality of Satisfactions.—Every satisfaction is good, and every denial of satisfaction is evil. If it be objected that some of our desires, if gratified, would lead to evil consequences, and that it is therefore untrue that every

denial of satisfaction is evil, I should reply that, while it is frequently right to postpone certain satisfactions for the sake of other satisfactions, this is no proof that the former would not have been good, or that their denial is not evil; it merely implies that the former satisfactions would have been *less* good than the latter and that the denial of the former is less evil than the denial of the latter. It is, indeed, a matter of common knowledge that many of our desires and purposes are incompatible; the fulfilment of one hinders or renders impossible the fulfilment of others. Nevertheless, *if* they could all be fulfilled, such total fulfilment *would be* better than the fulfilment of only some of them.

(b) The Quantitative Measure of Worth.—Of any two satisfactions, one of which is greater than the other in duration or intensity or both, the greater satisfaction has the greater worth.[7] This postulate introduces us to the principle of the "quantitative basis of preference." [8] The clearest application of this principle is to the case in which one of two proposed satisfactions includes the other and more besides. For where there are no differences in kind, but the satisfactions are related to each other as *more* and *less* of the same thing, no one would think of questioning the propriety of the assumption that the greater is better than the less. In other cases it may not be so obvious that our postulate applies. For satisfactions may differ in other respects than in duration and intensity, and our preferences may then be said to be determined by considerations of quality rather than of quantity.

Thus common sense recognizes a difference in the worth of various kinds of *pleasures;* but this need mean no more than that some pleasures are less likely than others to be followed by pains, and that some are more likely than others to pave the way for subsequent pleasures. Such pleasures as are not followed by pains, and such as tend to produce future pleasures, are superior.

[7] This would not apply, of course, to the case in which the satisfaction which is greater in duration is less in intensity or vice versa. (See p. 380.)

[8] See Perry, R. B., *The Moral Economy,* 1909, p. 55; *General Theory of Value,* 1926, pp. 598 ff.

In this way what seemed to be a difference of *quality* may be shown to be in reality a difference of *quantity*.

It is not necessary for us to maintain, however, that this can be shown to be true in every instance. All that our postulate requires is the recognition that, unless our preferences happen to be in agreement, or unless we all recognize some infallible authority, it becomes necessary for us to appeal, explicitly or implicitly, to quantitative considerations in the attempt to reconcile our conflicting desires and purposes. For otherwise, while there might be an interesting interchange of information concerning our judgments of value, it would be idle to argue that one judgment is true and another false.

(c) The Presumption of Equality.—Any two satisfactions are of equal worth unless they are known to be unequal in duration or intensity or both.[9] It is obvious that things which are not unequal must be equal. Our present postulate is not merely a corollary, however, of the preceding one. It contains an independent assertion. This new element is the assumption that in the absence of knowledge to the contrary all satisfactions are to be regarded as quantitatively equal. It follows, of course, that *all satisfactions are presumed to possess equal worth and all denials of satisfaction to possess equal unworth.* In other words, the burden of proof rests upon anyone who ventures to contend that the worth of one satisfaction, or the unworth of one denial of satisfaction, is greater, or less, than the worth or unworth of any other.

We are reminded of the assumption that *all men have equal rights* (see pp. 438 f). Indeed the democratic principle of equal rights may be considered a theorem which follows as a logical consequence from our present set of postulates, together with an additional postulate to the effect that all men are to be regarded, until the contrary has been established, as having an equal capacity for satisfaction (and also for pain and the appreciation of denials of satisfaction). On the other hand, the principle that the rights of animals are to be subordinated to those of

[9] See, however, Postulate (f).

human beings depends upon the assumption that their capacity for satisfaction is less than ours.

(d) The Greater Worth of the Greater Number.—In estimating the worth of any state of affairs, two satisfactions have more worth than one, unless this one is known to be greater than the others; and, with the same qualification, three have more worth than two, four than three, and so on. One is tempted to suppose that the worth of two satisfactions would be exactly *twice* as great as that of one. This, however, would run counter to our daily experience, which seems to forbid us to apply our arithmetical ideas without qualification to the compounding of satisfactions. We do not seem, as a rule, to get twice as much fun out of two pleasant experiences as we do out of one. Nevertheless, if there is to be any comparison of the worth of different complex experiences, the principle of addition cannot be entirely renounced; it is necessary to assume that the worth of two satisfactions is *greater than,* even though it may not always be exactly twice as great as, that of one.

(e) The Principle of Offsetting.—In estimating the net worth of any state of affairs, one or more satisfactions may be offset, in whole or in part, by a denial of satisfaction.[10] It is obvious that if there is to be any significant comparison between states of affairs which include both satisfactions and denials of satisfaction, this postulate must be granted. Nevertheless it must be admitted that satisfactions and denials of satisfaction are only imperfectly commensurable. We have seen that satisfactions cannot be added and multiplied like material things. The same is true *a fortiori* of denials of satisfaction. It does not seem to be worth while, indeed, to postulate, as we might be inclined to do, that two denials of satisfaction have more *unworth* than one, three than two, and so on; for too many complications must be recognized for such comparisons to be of any practical importance. Not only would we have to consider the differences

[10] Also by a "pain" or positive dissatisfaction. To inquire whether all pains and dissatisfactions should be included under the head of "denials of satisfaction" would lead us too far afield.

in the duration and intensity of the satisfactions which are supposed to be denied, but also the length of time through which the denial is likely to continue, as well as the persistence and intensity of the desire for that which has been denied. It seems clear, indeed, that there are cases in which the agent in question is so completely taken up with other satisfactions that some denials of satisfaction have no unworth at all. In such cases they can be considered *evil* only in the sense that they are *not good*. In a word, to return to the analogy of arithmetical calculation, denials of satisfaction would have to be represented in such cases, not by negative numbers, but simply by zero. (For a further discussion of this point see p. 408.)

(f) The Representative Function of the Near.—In estimating the net worth of a series of states of affairs some elements of which are remote in space or in time, such satisfactions and denials of satisfaction as can be clearly foreseen and directly taken into account may be regarded as representative of those which cannot. We shall return to this point in Chapter XV. (See pp. 426 f.) Suffice it to say here that differences in date or in personal reference do not seem to justify us in regarding one satisfaction as better than another. Nevertheless satisfactions or possible satisfactions that are remote in time or in place or in both cannot be put on quite the same plane with those which are nearer to us, for the reason that we know so little about them and that we are not likely to have as much control over them. Our third postulate, if it stood by itself (see p. 376), would require us to treat such remote and little-known satisfactions as equal in worth to those which are nearer and better known. It should perhaps have been qualified by a proviso to the effect that the satisfactions in question must be sufficiently near to us in space and time to be reasonably familiar to us.

Degrees of Goodness.—There is an obvious analogy between some of the "postulates of description" which we formulated in an earlier chapter (see pp. 283 ff.) and these "postulates of ethical discussion." The theory of method is the

same in both cases, namely, that we ought to make explicit the assumptions which underlie our thinking in whatever field.

There is, however, one point of difference to which it may be well to call attention. In the former account we did not postulate that every cognitive experience is *true,* but merely that all cognitive experiences have *an equal prima facie truth*-claim. In the present section we have postulated that every satisfaction, considered in isolation from all others, is *good.* We could not make the corresponding affirmation concerning cognitive experiences. Some of them, we found it necessary to assume, are *not true at all.* Otherwise it would have been necessary to accept the very questionable conception of "degrees of truth." (See p. 291.) There is no objection, however, to the analogous conception of "degrees of goodness"; for it is commonly recognized that the adjective "good" is a relative term. For this reason we have been able to say that all satisfactions are *good,* and to add that when all things are taken into account some satisfactions and groups of satisfactions are found to be *less good* than others.

If the reader, however, prefers the other form of statement, we shall offer no objection. Instead of affirming that all satisfactions are good, but that some are less good than others, we might very well be content to say that all have an *equal prima facie claim* to be regarded as good, and then to point out that upon further inquiry the goodness of some of them turns out to be illusory.

Limits of the Value-Calculus.—In order to avoid misunderstanding, it may be well to point out, even at the cost of some repetition, that there are serious difficulties in the practical working out of the method which we have suggested for determining the relative net worth of possible states of affairs.

In the first place, we must admit the difficulty, not to say the impossibility, of tracing out all the empirical inter-relationships between satisfactions and denials of satisfaction. We know only too well that some satisfactions must be paid for by subsequent denials of satisfaction; and that some denials and postpone-

ments of satisfaction are more than offset by the resulting satisfactions. Our difficulty, however, is to find out just what these empirical cause-and-effect relationships are. Broadly speaking, all of our applied science is an attempt to trace these interconnections.

In the second place, the calculus of values is very seriously hindered by the imperfect commensurability of worths and unworths. We may, to be sure, speak of "positive" and "negative" values; but it is impossible to determine our units in such a way that the algebraic addition of a positive and a negative value will be sure to yield zero. While we have, indeed, postulated the principle of offsetting, it is not possible to establish any *exact* quantitative relationship.

In the third place, it is only by leaving out of account any but quantitative considerations that even positive values can be treated as commensurable. As we have seen, the recognition of preferences based upon differences of quality would, so far as these preferences are concerned, destroy the possibility of argument or discussion.

Finally, it will be observed that no attempt has been made in any of our six postulates to balance differences in intensity against differences in duration. We have said that where neither of two satisfactions is greater than the other in duration or intensity or both, they should be regarded as equal; but if M has a greater intensity than N, but a shorter duration, I know of no way to determine which of these has the greater worth, or whether they should be treated as equal.

It is manifest, then, that there are some actual situations in which it is a matter of indifference which of two suggested lines of action is chosen; for there is no reason to believe that the net worth of the resulting states of affairs would be appreciably different.

On the other hand, there are many situations in which it will be perfectly clear that the state of affairs which may reasonably be expected to ensue upon one of two proposed lines of conduct will have greater net worth, if estimated in accord-

ance with our postulates, than the state of affairs which may be reasonably expected to ensue upon the other. In such cases, the agent's duty is clear; and the fact that our criterion is not applicable to *every* case is not a good reason for refusing to apply it where it *is* applicable. In general, we may affirm—and in this affirmation all of our postulates are really included—that human conduct is right if it tends to increase the net worth of the cosmos; or, to speak more modestly, it is right if it tends to increase the net worth of so much of the cosmos as may be affected by it.

Explicit and Implicit Postulation.—It must be understood, of course, that our six postulates of ethical discussion are not presented as the final, perfect, and only set which is logically possible. As we have seen, they are decidedly imperfect and in certain respects unsatisfactory. They are presented, however, in the hope that each reader may be incited to prepare a better list for himself. The essential point is that when we find ourselves engaged in discussions or disputations concerning matters of human conduct, we ought in the interest of clarity and mutual understanding to make plain which of our deliverances are meant to be taken as theorems, that is to say, as propositions that can be demonstrated, and which are to be regarded as *postulates*. I feel quite confident that if the reader will set to work and formulate the postulates which are logically implied by his reasonings concerning problems of conduct, he will find that most, at least, of our six have been included in his list.

3. Traditional Ethical Theories

It is suggested, then, that the acceptance of the postulates affirmed in the preceding section will enable us to construct a theory of right and wrong which is practically workable and at the same time logically sound. Before definitely committing ourselves to this position, however, it may be desirable to make a rapid survey of traditional ethical theories. Such a survey will reveal two rival points of view which, adopting the terminology employed in our discussion of the test of truth (see Chap. IX),

we may speak of as "intuitionism" and "rationalism."[11] The latter of these two general doctrines, which may also be designated as the "consequence theory," appears in several forms. These all agree, however, in holding that we should employ *reason* in order to decide what is right and what is wrong. According to *intuitionism,* on the other hand, it is not necessary to make use of "discursive reason" in order to find out what is right and good; for it is held by the protagonists of this point of view that we have an immediate knowledge of what we ought to do and of what we ought to seek.

Intuitionism in Ethics.—After what we said above (see Chap. IX) about the inadequacy of intuitionism as a theory of the test of truth in general, the reader will not expect us to be satisfied with it as a theory of the ethical criterion. As we pointed out in the previous discussion, mere immediacy of apprehension is not a sufficient evidence of truth; and, even if it were, it would be necessary to admit that our moral judgments are as a rule not nearly so immediate as they seem to be.

The Doctrine of Conscience.—By some writers the intuitionist theory has been developed as a doctrine of *conscience.* Each of us, it is said, has an inner voice, an infallible monitor, a "little man within the breast," that tells us what is right and what is wrong. Our part is not "to ask the reason why," not to inquire into the probable consequences of the activity upon which we are about to embark, but simply to follow unquestioningly the dictates of our own conscience.

Now it must be admitted, I think, that the maxim, "Follow conscience," is sufficient for most of us at least nine-tenths of the time. We instinctively condemn a person who lets the end

[11] As pointed out in our previous discussion (see pp. 263 ff.), the distinction between *intuition* and *reason* may readily be misunderstood. They should not be regarded as independent *faculties,* but should rather be thought of as part and whole of the same cognitive process. The immediacy and self-evidence of our intuitive judgments are not a sufficient guaranty of their trustworthiness. They must be evaluated in the light of their compatibility with one another and with other data of experience, as well as with already accepted concepts and principles. And this comparison and evaluation is what we mean by reason.

justify the means; we honor the man who at any cost whatsoever is loyal to his own conscience. Nevertheless we must distinguish between complete moral rightness and mere conscientiousness. The person who follows conscience is *subjectively* right. From the subjective point of view his deed must be accounted good, however deplorable the consequences to which it perchance may lead. This, however, is not enough. In addition to subjective rightness, we should also have *objective* rightness. Indeed, the man who follows conscience, but whose conscience is unenlightened, is as likely as not to become a crank, a fanatic, a common nuisance.

The conscience of the Bedouin inculcates blood-revenge. The Christian conscience requires forgiveness. Both cannot be right; one, at least must be wrong. It is manifest, then, that behavior which is subjectively right may be objectively wrong; our immediate ethical judgments are not always correct. Indeed, the psychologists tell us that what is popularly called "conscience" is but the echo within us of the opinion of the social group to which we belong. Our sense of duty is a consequence of social pressure. What seems to us to be an immediate judgment of the rightness or wrongness of a proposed line of action is the result of the moral training which we received in our childhood and youth, and of a long series of choices and moral judgments which we ourselves have made. The fact that my conscience pronounces a certain type of behavior right or wrong, as the case may be, is no proof that it *is* objectively right or wrong, but merely that *I* had a certain kind of training and experience.

The Formalism of Kant.—In the variant of the intuitionist theory which we have been discussing, the immediate judgment, or intuition, is supposed to be directed to each act or type of act which the agent is solicited to perform. It is possible, however, to think of the intuition as relating to the *intention* or purpose of the agent, rather than to his actual behavior. Under this head belongs the ethical theory of Kant. He contends that an act derives its moral worth, not from the nature of the act itself, nor yet from the consequences which may reasonably be

expected to flow from it, but from the "maxim" by which it is determined. To be good, in the strict sense of the term, an act must be done from duty rather than from inclination. For ex-example, Kant says,[12] "It is a duty to maintain one's life; and in addition, everyone has also a direct inclination to do so. But on this account the often anxious care which most men take for it has no intrinsic worth, and their maxim has no moral import. They preserve their life *as duty requires,* no doubt, but not *because duty requires.* On the other hand, if adversity and hopeless sorrow have completely taken away the relish for life; if the unfortunate one, strong in mind, indignant at his fate rather than desponding or dejected, wishes for death, and yet preserves his life without loving it—not from inclination or fear, but from duty—then his maxim has a moral worth."

Similar observations are made by Kant about seeking one's own happiness, and even about contributing to the happiness and well-being of others. To be of moral worth, all must flow from duty rather than from inclination. Now the essential element in the notion of duty, as understood by Kant, is the idea of a good will. Accordingly "nothing can possibly be conceived in the world, or even out of it, which can be called good without qualification, except a good will."

Difficulties arise, however, when we inquire just what we are to understand by the phrase "a good will," and just how we are to know when the will is good. We can hardly mean simply that the will is *strong* or *efficient;* although the idea of strength or efficiency for its own sake has a certain attractiveness for many of us. Kant's own interpretation is that the will is good when it is determined by respect for *law.* "I am never to act otherwise," he says, "than *so that I could also will that my maxim should become a universal law.*" In other words, conduct is right if it can be universalized; that is to say, if everyone else could act in the same way.

Now it is evident that in practice this principle is of great

[12] *Metaphysics of Morals,* First Section.

value in determining whether a proposed line of conduct would or would not be morally right. I must claim no privileges for myself which I am unwilling to grant to others. It is an essentially democratic principle; for it would rule out all pretensions of class or caste whatsoever.

Nevertheless, when we try to apply the principle to actual situations, we encounter difficulties. I shall mention only two. In the first place, the principle of universality would seem to forbid all *specialization*. For it would not be right for me to spend the best years of my life in preparing, let us say, for the practice of law or medicine unless I am willing that everyone should do the same. If it be said in reply that I should have to grant this only in the case of those who are in the same situation with myself, we meet the difficulty that no two persons are ever in exactly the same situation, and that as soon as we begin to take into account special circumstances and individual idiosyncrasies, we have really given up the principle of universality.

In the second place, a difficulty arises when we ask why it is impossible, as Kant alleges, that I should wish the "maxim" of a wrong act to be a universal law. Some cases of wrongdoing might, indeed, be covered by the notion of logical and factual impossibility. For example, the wrongfulness of walking across the grass might be explained by pointing out that if everybody did it nobody could do it—for the reason that there would no longer be any grass to walk across. In the same way it can be shown to be impossible for me to wish that everybody should tell lies; for, if the habit of departure from the truth became widespread, no one would any longer believe anything that might be said, and no lie could then really be told. There are only a few types of conduct, however, to which the principle of universality can be shown to apply in this narrowly logical sense; and in practice the reason for my inability to will that the maxim of any given "wrong" act should become a universal law of conduct is my unwillingness to envisage the consequences which would flow from its universalization. I must not

steal, I must not kill, I must not lie; because, if everyone did these things habitually, life would become intolerable.

In short, Kant's principle of universality owes its value as an ethical criterion to the fact that in practice we cannot avoid a tacit reference to the probable consequences of proposed types of conduct. Kant, however, continually protests against making the consequences of our behavior the test of its moral quality. That is why his ethical doctrine is purely formal. In the last analysis, his position is found to be simply that we should *do right*. It is my duty to do my duty at all times. The only moral law is that I should always obey the moral law.

The Consequence-Theory.—We conclude, then, that if there is to be any criterion of conduct, it must be found in a consideration of the consequences. Conduct is right if it may reasonably be expected to lead to good consequences; it is wrong if it may reasonably be expected to lead to evil consequences. It is always the *end* which gives moral quality to the means. Observe, however, that we have not said that the end *justifies* or sanctifies the means. There are certain implications of this notorious old maxim which we cannot approve, and which the consequence-morality need not accept. If we should say that "the end justifies the means," the implication would be that the means are already known to be evil, but that they are purged of their evil quality by the superior goodness of the end. According to a consistent consequence-theory, however, the means, considered simply as means, have no moral quality whatsoever, but become good or bad, right or wrong, only by reference to the totality of consequences which they may reasonably be expected to produce.

This consequence-theory of morality, or ethical rationalism, as it may also be called, has appeared historically in two rival forms. One of these is known as the theory of *perfectionism* or *self-realization;* the other as *hedonism* or the *pleasure-pain* theory. According to the former theory, the consequences which are to be considered in passing judgment upon the moral quality of an act are its probable effects upon the character and

personality of the agent himself and of such other persons as may be affected by it. According to the latter theory, the consequences to be considered are the pleasures and pains, the happiness or the unhappiness, likely to result from the proposed act.

The Theory of Self-Realization.—It must be admitted, I think, that the theory of self-realization is the more edifying of the two forms of the consequence-theory. A young man goes to college, not merely to fit himself for a profession whereby he may be able to earn a living, but also to develop himself, to make of himself the best man that he is capable of becoming. In short, he seeks not only to be *trained* but to be *educated*. The self-realization theory sets before each one of us the ideal of a full-orbed, symmetrical development of personality. One's physical, mental, and spiritual possibilities are all to be realized to the fullest extent. That which is only latent in the child and the youth is to arrive at complete fulfillment in the full-grown man.

Two remarks must, however, be made concerning the theory of self-realization. In the first place, it is in danger of becoming a selfish theory. For the individual who adopts it as his rule of life may be tempted to subordinate all things and all other persons to the development of his own personality. In order not to criticize the theory of self-realization unfairly, however, it should be observed that most of its expositors quote with approbation the noble words of Kant, *"So act as to treat humanity, whether in thine own person or in that of any other, in every case as an end withal, and never as a means only."* Thus the theory would set before us as the ideal goal of life, not the realization of *a* self, but rather of *a community* of selves.[13]

In the second place, the self-realization theory gives us no basis for decision between the various conflicting possibilities of individual selfhood. In developing one aspect of my personality, it is inevitable that I neglect others; for some of these *possible selves,* if we may speak of the diverse aspects of personality in this way, are mutually exclusive. As James expresses

[13] See, for example, Calkins, M. W., *The Good Man and the Good.*

the difficulty,[14] "With most objects of desire, physical nature restricts our choice to but one of many represented goods, and even so it is here. I am often confronted by the necessity of standing by one of my empirical selves and relinquishing the rest. Not that I would not, if I could, be both handsome and fat and well dressed, and a great athlete, and make a million a year, be a wit, a *bon-vivant,* and a lady-killer, as well as a philosopher; a philanthropist, statesman, warrior, and African explorer, as well as a 'tone-poet' and saint. But the thing is simply impossible. The millionaire's work would run counter to the saint's; the *bon-vivant* and the philanthropist would trip each other up; the philosopher and the lady-killer could not well keep house in the same tenement of clay." The reader may protest that several of the "selves" listed by James would not be considered for a moment by any respectable person; but his protest proves simply that *he* has already chosen what manner of self he wishes to be; and does not alter the fact that the theory of self-realization gives us no ground upon which to base a choice between inharmonious aspects of personality. In deciding between conflicting possibilities of selfhood, we must then depend upon intuition, or if we are afraid that our intuitions cannot be trusted, we must have recourse to the other form of the consequence-theory.

Hedonism as an Ethical Theory.—This brings us to the form of the consequence-theory which is known as *hedonism.* The term is derived from a Greek word meaning "pleasure"; and hedonism may be briefly described as the theory that the good is pleasure and avoidance of pain.[15] Ethical hedonism must be carefully distinguished from what has been called psychological hedonism. The latter is the view that a human being is governed in all of his activity by a desire for pleasure. It is an exploded doctrine, which no contemporary psychologist would defend, and from our present point of view is important only

[14] *Psychology,* 1890, Vol. I, p. 309.

[15] In this discussion the term "pain" must be understood, not as denoting a form of cutaneous sensitivity, but rather as a synonym of unpleasantness.

because it has so often been confused, both by advocates and opponents of the latter doctrine, with ethical hedonism.

Another misunderstanding which must be avoided if we would be fair to the hedonist is the idea that "pleasure" denotes only bodily satisfactions. As the term is used in these discussions, it means any kind of satisfaction whatsoever, the so-called higher satisfactions as well as the so-called lower satisfactions. It is indeed an essential element of hedonism to maintain that all pleasures have an equal *prima facie* claim to be considered *good*. According to this theory there would be, so to speak, a democracy of satisfactions; each satisfaction would be esteemed good unless and until it was proved to be evil.

Pure Hedonism.—We may distinguish three stages in the development of the general hedonistic position. These are known, respectively, as *pure hedonism, egoistic hedonism,* and *universalistic hedonism.* Pure hedonism would hold that each of us should seek the pleasure of the present moment regardless of consequences. While some perhaps seem to be pure hedonists in practice, I know of no one who has ever held pure hedonism as a theory. For the ancient Greek philosopher to whom this extreme doctrine has been attributed is said to have remarked that one "should be prudent even in gathering rosebuds." And as soon as one begins, in his quest of satisfactions, to avoid those which are surrounded by thorns, he is no longer a pure hedonist.

Egoistic Hedonism.—It is indeed this virtue of prudence which distinguishes egoistic hedonism from pure hedonism. The egoistic hedonist seeks for a lifetime of happiness rather than for successive moments of pleasure. He recognizes that he who eats least is likely in the long run to eat most. Following the example of Epicurus (342-270 B.C.), the egoistic hedonist prefers barley bread and water to richer fare; for he is persuaded that he will in this way gain the greatest amount of pleasure and the least amount of pain. He believes too that the satisfactions derived from social intercourse—poetry, painting, music, etc.—are better, because in the long run safer, than the so-called "lower" pleasures. The consistent hedonist does not, however,

regard one set of pleasures as better or worse *per se* than another; the so-called "higher" pleasures are higher or better only in the sense, as suggested a moment ago, that they are safer, because less likely to be accompanied or followed by pain.

While egoistic hedonism, as the term implies, teaches that the agent shall seek his own happiness, and does not inculcate any concern for the happiness of others, it is important to note that an enlightened egoist would be a pretty decent sort of fellow. Two automobiles traveling over the same road in opposite directions usually turn out; and this need not imply altruism on the part of either of them; for each would turn out because he loves himself. Thus it is doubtless true that even in Christian Europe and America the social order rests very largely upon self-interest. And we may hope that the increasing enlightenment of the masses of the nations, even without much increase in altruism, will lead eventually to the abolition of war and other glaring evils of modern life. (See pp. 434 ff.)

Universalistic Hedonism.—It is doubtful, however, whether any sane human being was ever completely egoistic. It is safe to say that at least nine-tenths of our conduct serves both ourselves and others; and pure egoism and pure altruism are nonexistent abstractions. It may be suggested, indeed, that enlightened selfishness and enlightened altruism would in practice be indistinguishable. For the typically "selfish" person is the one who lacks knowledge and imagination. He is therefore unable to enter sympathetically into the experiences of others, still less to see himself as others see him. In so far, then, as enlightenment permits the rise of sympathy, the hedonist finds it psychologically impossible to be utterly unconcerned about the happiness of his fellows.

To be sure, it is not possible to prove with logical cogency that a man ought to be interested in the happiness of others—any more than it is possible to prove that the self of the present moment ought to be concerned about the happiness of future "selves" of the same series. As a matter of fact, in the case of each one of us, the self of the present moment *is* concerned

about "his own" happiness ten years from now; and also as a matter of fact, each of us is interested in the happiness of others. Moreover, it is impossible to prove that one self ought *not* to be interested in the happiness of others. For if, as the hedonist maintains, each satisfaction has the same *prima facie* claim as any other, the circumstance that one satisfaction occurs to-day and another ten years from now, or that one happens to be an element in *your* mental life and the other in *mine,* is entirely irrelevant. There is, indeed, no rational ground for preferring a present satisfaction to a future satisfaction, or my satisfaction to yours.[16] (See p. 376.)

The same considerations, then, which make it inevitable that the enlightened hedonist should prefer egoistic hedonism to pure hedonism, suggest that he move forward to universalistic hedonism. According to this form of the theory, the good to be sought by each moral agent is not simply his own happiness, but, to quote the famous words of Jeremy Bentham (1748-1832), "the greatest happiness of the greatest number."

Here at last, in spite of all that may be said about the difficulties involved in the calculation of satisfactions, we have a workable criterion of conduct. Our behavior is morally right when we have reason to believe that it will increase the sum-total of happiness; it is wrong when we have reason to believe that it will subtract from the sum-total of happiness. While in many cases it is impossible to be absolutely certain which of two proposed lines of conduct will contribute most to the total amount of happiness, there are many other cases where there can be no doubt whatsoever. At any rate, it is to this principle that we all appeal when our conduct is questioned or when we are in doubt as to which course should be chosen. We profess to be seeking the greatest good of all concerned; and even if we are reluctant to *identify* the good with happiness, we must admit that happiness is, in practice, the only available measure of the good.

[16] Unless perhaps this, that the future satisfaction is less certain, and your satisfaction less subject to my control. (See p. 378.)

A Conspectus of Ethical Theories.—A diagram may help us to see the inter-relations of the traditional ethical theories:

- Ethical Theories
  - Intuitionism
    - The Theory of Conscience
    - The Formalism of Kant
  - The Consequence-Theories (rationalism)
    - The Theory of Self-Realization
    - Hedonism
      - Pure
      - Egoistic
      - Universalistic

4. The Authority of Values

After our survey of ethical theories we return to the position that morality is essentially an adjustment of competing purposes which is effected in such a manner as to seek a maximum of fulfillment with a minimum of frustration. (See p. 374.) This theory may be regarded either as another way of putting universalistic hedonism, or as a compromise between universalistic hedonism and the self-realization theory. Accordingly, instead of speaking, on the one hand, of "happiness" or of "pleasure"—terms which, in spite of all the hedonists' protests and explanations, suggest satisfactions of a low order—or, on the other hand, of the "realization of the self"—a concept which presupposes a more definite and unified notion of selfhood than we have a right to adopt—we speak of the *fulfillment of purposes* or of interests. Although every satisfaction or fulfillment is to be regarded as good *per se,* interests frequently conflict. Therefore, in order to secure the maximum fulfillment of interests, some of them must needs be postponed or even entirely repressed. Thus, if one is prudent, he frequently subordinates the interests of the moment to those of his larger self; while, if one is controlled by love, he subordinates his individual purposes to the interests of the community of which he feels himself to be a part. Morality is, then, an organization of interests; and our conduct is *right* when it leads to satisfactory consequences.[17]

[17] Cf. Perry, R. B., *The Moral Economy.*

Supernaturalism in Ethics.—To many persons, however, our doctrine that judgments of right and wrong are to be determined by a view of the consequences is likely to be positively shocking. It will seem to them to give us either no morality at all, or else one which is too fluid and indefinite to be worthy of respect. And in seeking to satisfy their craving for an ethics which is *absolute,* that is to say, which is not in any sense dependent upon considerations of time, place, or circumstance, they will probably fall back upon the conception of a supernaturally revealed code of morals.

There are several reasons, however, which make it impossible for the student of philosophy to regard supernaturalism in ethics as a satisfactory position.

In the first place, it cannot be supposed that "revelation" makes conduct right or wrong—as, for example, the constitution of the United States makes certain procedures constitutional or unconstitutional. Probably no one would maintain that right is right *only* because it is commanded, and that wrong is wrong only because it is forbidden. But if we hold—as it seems to be inevitable that we should hold—that rightness and wrongness are logically prior to the commands and prohibitions by which they are brought to our attention, there must then be some reason for these pronouncements other than the revelation itself.

In the second place, a study of the sacred writings of Christianity, as well as of other religions, suggests that revelation has been *progressive,* in other words, that what is revealed to any given generation depends upon the capacity of that generation to apprehend moral truth. From this it follows that it is never safe to say of any particular ethical teaching, "This is true *because* it is found in sacred scripture." For example, in the Bible slavery and polygamy are recognized institutions, and are nowhere condemned. Are they right to-day? If not, why not? Again, in certain parts of the Old Testament, we find the principle of "an eye for an eye and a tooth for a tooth." The "imprecatory Psalms" shock the moral consciousness of the

men and women of the twentieth century. Indeed, it is very easy to go through the Old Testament and to pick out passage after passage which is obviously contrary to what we now regard as ethically right.

Finally, no one actually follows or indeed professes to follow all of the injunctions of Holy Writ literally. "If thine eye offend thee," should you really "pluck it out"? Is it really necessary to hate one's father and mother in order to be a true disciple? And what shall we say of the injunction, "Give to him that asketh of thee, and from him that would borrow of thee turn not thou away"? These well-known passages are quoted from the New Testament, not in a spirit of irreverence or cynical smartness, but simply to enforce the obvious thought that the "rule of reason" must always be employed, and in fact is always employed, in interpreting the precepts of sacred scripture. It is inevitable that we should pick and choose; that we should consider some things essential and others unimportant; that in some places we should insist upon a literal and in others upon a figurative interpretation. In short, the meaning which is derived from any given passage of sacred scripture depends, not wholly or even chiefly upon the literal meaning of the words and phrases which it contains, but much more upon the reason and conscience of the interpreter.

The Relativity of Moral Judgments.—There is, then, a sense in which all our moral judgments are relative to time, place, and circumstance. There are no rules of right which possess validity apart from the situation in which the agent is placed; and, as the situation changes, the rules of right which good men set for themselves and their children must also change. In short, there has been an evolution of morals, so that some types of behavior which were right at earlier stages of human development are now wrong and *vice versa.*

This must not be understood to mean, however, that all morality is purely conventional or that there are no moral laws. The rather widespread idea that accepted morality is merely a case of " 'tis thinking makes it so" may be psychologically ex-

plicable as a natural rebound from the rigidity of traditional supernaturalism and authoritarianism; but it is not capable of logical justification.

It may be admitted, indeed, that a large part of etiquette is a matter of convention. It is not absurd to suggest that a congress of deans and chaperons might bring about changes in the laws of polite behavior, so that some things which are now proper might become improper, and *vice versa*. Thus there does not seem to be any rational necessity for the rule that you shall not eat with your knife; that you shall not cool your tea by pouring it into your saucer; that you shall not spread out your napkin to its full size, or even stuff one corner of it into your collar, if you wish to do so. All of these improprieties are obviously cases in which " 'Tis thinking makes it so."

It must be granted, too, that grammatical correctness is very largely a matter of convention. For example, should we say "It is I," or "It is me?" The former, of course. But why? There is no real reason, except that of established usage; and this is all-sufficient. Again for exactly the same reason, or lack of reason we say, "It blew"; but no one would think for a moment of saying, "It snew."

Now Nietzsche (1844-1900 A.D.) and the Sophists (fifth century B.C.) would have us believe that our traditional morality is similarly conventional. Right is right only for those who think it is. The enlightened man, they hold, knows better; and the strong man, the "superman," need have no scruple about breaking through the cobweb of restrictions imposed upon his activity by the "slave-morality" of the multitude.

As we have already suggested, this attitude toward morality is a natural reaction against the excessive rigidity of the supernaturalistic theory of morals. It may be regarded as an extravagant version of the essentially true doctrine that values are relative to conditions and circumstances. What is right for one man may be wrong for another. What is wrong to-day may with changing conditions be right to-morrow. This may be granted, in principle; but it is extravagant to overlook the value of gen-

eral rules and precepts. For with all our differences, there still remains sufficient similarity between man and man—yes, even between the slave and the superman—to justify a considerable amount of generality in principles of conduct. And while there ought to be changes in the *mores,* to conform to changed conditions of human living, the code is not likely to change very much in any one generation.

The Analogy of Hygiene.—In making our escape from an irrational morality of tabu and supernatural sanctions, we must avoid the error of rushing into an equally irrational amorality and subjectivism. A helpful analogy may be drawn between laws of health and moral laws. If someone should maintain that we ought to bathe regularly, sleep with open windows, avoid certain kinds of food, take daily exercise, etc., etc., because God has so commanded, we should very likely object, first, that we have no satisfactory evidence that a supernatural revelation of this kind has actually been given; and secondly, that if God has indeed given us laws of health, there must be a scientific reason for them in addition to the circumstance that they have been supernaturally revealed. We should also insist that the laws of health are relative to time, place, idiosyncrasy, and circumstance. "What is one man's meat is another man's poison"; and there are, it would appear, situations to which even the gospel of the bath and the open window would not apply. Nevertheless it would be a foolish and extravagant reaction against a doctrine of supernatural and eternally immutable hygiene if we were to maintain that there really are no laws of health. The case is well put by Professor Everett:[18] "Although certain fundamental physiological processes remain the same at all stages of life, there is," he says, "a sufficient change to necessitate a radically different regimen at different periods. What is hygienically good for an infant is not required for an adult, nor are the same rules of exercise and diet suited to youth and old age. Following the suggestion afforded by the growing organism, we may regard the changes in moral codes as the

[18] *Moral Values,* 1918, p. 326.

necessary expressions of a developing human society which becomes progressively aware of the true needs and values of life."

Objectivity of Moral Judgments.—There is, then, a sense in which moral judgments are objective. They are not matters of mere caprice or convention. There is, indeed, an evolution of morals; and there is therefore a sense in which moral judgments may rightly be said to be relative. To say that they are relative is not the same, however, as to say that they are subjective or invalid. The judgment that B is taller or stronger or richer than C may be said to be a relative judgment; for it is a judgment about a relation; and this relation, moreover, is subject to change. Nevertheless this judgment may be, at a given time, just as absolute or objective or true as any judgment can possibly be. Similarly our moral judgments are judgments about relations, some of which are subject to change; but the relations themselves are, for the most part, at any given stage in social evolution, independent of our process of judging. For, to quote a famous saying of Bishop Butler (1692-1752), "Things and actions are what they are, and the consequences of them will be what they will be; why then should we desire to be deceived?"

An advocate of the consequence-morality cannot, then, be justly accused of subjectivism. To quote again from Professor Everett, "Moral law is just as real as human nature, within which it has its existence. Strange, indeed, if man alone of all living beings could realize his highest welfare in disregard of the principles of his own nature! . . . Indeed the skeptic nowhere else assumes the absence of principles through obedience to which the highest form of life can be attained. He does not assume that a lily, which requires abundant moisture and rich soil, could grow on an arid rock, nor that a polar bear could flourish in a tropical jungle. No less certain than would be the failure of such attempts, must be the failure of man to realize, in disregard of the laws of his being, the values of which he is capable. The structure of man's nature, as conscious and

spiritual, grounds laws just as real as those of his physical life, and just as truly objective." [19]

The Transformation of the *Mores*.—Man's "nature," however, is not so fixed and definite as that of the lily or the polar bear; neither is he adapted to as narrowly specialized an environment as they appear to be. In man's case, too, the social environment is even more important than the physical environment; and with the progress of civilization both his social environment and his physical environment are subject to significant changes. It is inevitable, then, that the *mores* of different human groups should differ very greatly, and that those of any given group should be altered in response to changing conditions.

Now if the rules of morality were conventional merely, if they were not grounded in the nature of man and determined by conditions as they actually exist, we might adopt toward our changing *mores* the same light-hearted attitude which the prudent man adopts toward changing fashions of etiquette, of dress, or of language. "Be not the first by whom the new is tried, nor yet the last to lay the old aside," would then be the maxim of the wise man. In all matters of conduct we could then simply play safe, and follow the crowd. But if, as we have maintained, morality is in the final analysis an adjustment of interests such as to secure, on the whole and in the long run, a maximum of fulfillment with a minimum of frustration, it may not always be possible to go with the crowd. It may sometimes be necessary to conserve when the crowd is disposed to innovate; and sometimes be necessary to innovate when the crowd is disposed to conserve.

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CHAPTER XIV

THE BELIEF IN PROGRESS

If the goal of ethical endeavor is the maximum of fulfillment of interest, it is natural to inquire whether the future may reasonably be expected to show an increase in the ratio of fulfilled to unfulfilled desires and purposes. For every normal human being is interested in the fulfillment of others' interests, as well—although perhaps not so much—as in the fulfillment of his own. And it is manifest that in both the remote and the recent past there has been a great deal of frustration. Many needs and desires have remained unsatisfied. There are indeed very plausible grounds for the belief that on the whole there has been more frustration than fulfillment, more unhappiness than happiness, more sorrow than joy, more evil than good.

But what of the future? We all wish for a future that shall be better than the past and the present. In a word, we wish for progress; and in some of us this wish has been transformed into a *hope* or even into a *belief* which is buttressed and supported by the acceptance of the general theory of evolution.

It must be admitted, of course, that evolution may produce evil as well as good; and that such reinforcement of our faith in progress as has resulted from the vogue of the evolutionary conception may not be logically justified. Nevertheless, in many of us the faith in progress is very real, and for some of us at least it is very precious.

1. The Contribution of the Social Sciences

In our discussion of the right to believe in progress we naturally look for help to the social sciences. It is scarcely possible, however, to formulate a list of achievements in the case of the

social sciences which would be comparable to those of astronomy, physics, chemistry, etc. There is a rough serial relationship of the sciences, a relation of logical dependence, so that physics presupposes mathematics, and chemistry physics, and biology chemistry, and psychology biology, and sociology psychology. We need not be surprised, then, to discover that the sciences which appear later in the scale are relatively less certain and complete than the earlier ones. Accordingly, if sociology is still a relatively backward science, as is evidenced by our difficulty in putting our fingers upon propositions which can be listed as accredited results, this must not be regarded as the fault of the workers in this field, but may more justly be ascribed to the incompleteness of the sciences upon which sociology depends.

There are, however, several generalizations of the social sciences which are now almost universally accepted, and which are capable of definite formulation. These I shall present, very briefly, in order to gain perspective for our further discussion of the problem of progress.

(a) The Discovery of Tools, Presumably Fashioned by Man, which Were in Use More than 200,000 Years Ago.— Instead of less than 6000 years, as suggested by a literal reading of the biblical narrative, at least 200,000, probably 500,000, and possibly more than a million years, are now spoken of by geologists and anthropologists as the period during which the human species has already been in existence. For tools and other remains of man have been found which certainly date from the Pliocene age, and it is said to be highly probable that beings very similar to us existed in the Miocene. To be sure, when we speak of history in the sense of a continuous written record of human events, we cannot go back more than about 2500 years; but by the discovery of monumental and other remains it has been proved that a fairly high degree of civilization existed as long as eight millenniums ago, especially in Mesopotamia and the valley of the Nile. Thus as the vista of history and prehistory is pushed back farther and farther, we are coming to real-

ize that the Hebrews, the Phœnicians, the Greeks, and the Romans, of whom we learn in what is still commonly called "ancient" history, ought really to be regarded as modern—as, indeed, almost contemporary with ourselves. This should always be borne in mind when we debate the question, "Is the world getting better?"

(b) The Description of Primitive Customs and Thought-Forms.—Modes of living and ways of thinking have been found among contemporary savages which in all probability were current, say 20,000 or 50,000 years ago, among our own ancestors. As examples we may mention the ideas and forms of behavior to which anthropologists give the names "totem," "tabu," and "magic." These ways of acting and of thinking having been found among contemporary savages, it is then inferred that our primitive ancestors had similar customs and thought-forms. The inference is, to be sure, somewhat precarious; but there are several considerations which make it very plausible. In the first place, there are survivals of "primitive" thinking even in civilized nations or communities. Superstitions of various sorts abound, especially among the uneducated. In the second place, ancient writings contain many reminiscences of primitive ideas and beliefs. And finally, the inference that our ancestors lived and thought in very much the same way as contemporary savages is supported by the general idea of evolution. It is of course logically possible that the golden age was in the past, that early men were highly civilized, and that the savage tribes of the present day are degenerate branches, black sheep, so to speak, of the human family; but the evolutionary point of view suggests the contrary hypothesis.

(c) The Recognition that Existing Institutions Are Historically Continuous with Those of Primitive Man.—In the eighteenth century, human institutions such as the church, the state, and the family were discussed and criticized as if they had been invented and set up shortly before. Abuses were attributed to the craft of priests and the tyranny of kings. It was not realized that these institutions had behind them cen-

turies and millenniums of development; at any rate, the time element was not taken into account as much as it ought to have been in the discussion of social problems and in the agitation for reform. Indeed, there was a widespread tendency to seek revolution rather than reform; for, controlled by this unhistorical point of view, men could go blithely ahead with the destruction of existing forms of order in the confidence that better structures could be quickly and easily erected on the ruins of the old. We have come to see, however, that institutions are not *made;* they *grow.* And the realization of this fact affects our attitude toward social and political problems in two different ways:

(1) It makes us *more patient.* We do not expect to make radical changes in the social order over night. We are slow to destroy existing institutions, because destruction might simply set the clock back a century or two. We believe that the present, in spite of all its shortcomings, is a necessary stage in the evolution of a better future.

(2) It makes us *less complacent* with things as they are. This statement may seem to be opposed to the thought of the last paragraph, but in reality it is not; for, while the present is a necessary stage in the evolution of a better social order, it is only a stage. It is not the final and complete social order. It is capable of being improved—more rapidly with our help, or more slowly, in spite of our opposition. Church, state, family, industry, education—all of these have changed in the last five hundred years; and it is likely that they will change as much or more in the five centuries which are just ahead.

(d) The Recognition that Our Superiority to Contemporary Savages and to Our Primitive Ancestors is Due Chiefly to Our More Fortunate Social Environment.—Civilization appears to have resulted from an accumulation of inventions rather than from an increase in native intelligence. This is a point that deserves emphasis in view of certain claims that the white race, or the "Nordic" strain within the white race, is far superior to all others. It must be remembered that simi-

larity of language does not prove similarity of race; and anthropological investigation reveals that no existing race is "pure." There may, indeed, be innate differences among the various divisions of the human species. A given subdivision of mankind may be naturally superior in some respects and inferior in others. On the other hand, it is always possible to argue that such mental and moral differences as are found between "races"—as, for example, between Caucasians and Mongolians—are of *sociological* rather than *biological* origin. Indeed, the weight of competent anthropological opinion seems to incline to the view that this is the case.

What is lacking, then, in the case of contemporary savages is a cultural tradition. This was also true of our primitive ancestors. Our superiority consists in the fact that we are standing on the shoulders, as it were, of the generations which preceded us. We are therefore able to see farther than they could.

This point of view may seem discouraging to the enthusiastic believer in progress. In reality, however, it ought to be encouraging; for although it does not suggest the speedy appearance of a race of supermen, it permits us to hope for a gradual improvement in human thinking and living. The abolition or mitigation of the evils of our present social order need not wait for any radical change in "human nature"; they may reasonably be expected to result from the progressive education of the human race.

2. Pessimism

Contemporary science, then, with its view of an evolving planet and its ascending scale of animal, savage, and modern civilized man—however this evolution may, in detail, be described or explained—lends encouragement to the doctrine of progress. We may well inquire, however, whether when viewed critically and in a wider perspective this appearance of progress will not be found to be illusory.

Is the world really getting better? Is life worth living? Is the world, on the whole and in the long run, predominantly

good, or is it predominantly evil? Questions such as these introduce us to the issue between the optimistic and the pessimistic view of the world. In part the difference in viewpoint is a matter of temperament. Some people are always melancholy, gloomy, downhearted, and despondent; others, on the contrary, are sanguine, cheerful, hopeful. The former see nothing but dark clouds ahead and overhead; the latter see that the clouds have a "silver lining." The former find a melancholy satisfaction in dwelling upon the sinfulness and misery of humanity; the latter are pleased to discover that this world of ours is a pretty good place after all.

In popular speech the terms "pessimism" and "optimism" are thus employed, somewhat loosely, as names for a despairing and a hopeful attitude toward life. In technical philosophical usage, however, pessimism is defined as the doctrine that *the world is so very bad that it ought not to be at all;* while optimism is the doctrine that *this world of ours is the best of all possible worlds.* As a *via media* between these extreme positions, it may be held that, while the world has been and still is pretty bad, it is nevertheless reasonable to hope and work for its *improvement.* This last doctrine—which is, I suppose, about what is meant in popular discussion by optimism—has been called *meliorism.*

The Philosophy of Schopenhauer.—The most celebrated advocate of philosophical pessimism is Arthur Schopenhauer (1788-1864). He was profoundly influenced by the sacred writings of Buddhism, with its doctrine of Nirvana and the Eightfold Path. According to Schopenhauer's metaphysics, everything that exists and takes place in the cosmos is a manifestation of the Will-to-Be. This basic Will must not be identified too closely with what we know as will or volition in human experience; for, as employed by Schopenhauer, the term Will stands for a blind, unconscious, unintelligent striving or tendency, which is exemplified more typically by the instinctive behavior of animals, by the tropisms of plants and lower forms of animal life, or even by the operation of "forces" such as gravitation, magnetism, etc., than by the consciously purposive activity of

human beings. To be sure, human volition, like everything else, must be regarded as a manifestation of this basic Will.

The Will-to-Be, or as it becomes in certain of its manifestations, the Will-to-Live, is similar in many respects to Bergson's *élan vital* or to that "design" *which is not assumed to have been designed,* to which reference was made in a preceding chapter. (See pp. 359 ff.) Bergson, however, and the majority of recent voluntarists have not been pessimists. The fundamental *élan* or striving has been regarded by them in some mysterious and indefinable sense as good; that is to say, as tending toward the realization of some indescribable but worthy goal. According to Schopenhauer, on the contrary, pessimism is a necessary logical consequence of the voluntarist point of view; for when, in man and the higher animals, the Will-to-Be blundered, so to speak, into consciousness, the tragedy of cosmic misery began. For with consciousness came suffering. To be sure, the world contains enjoyment too; but it is inevitable that the amount of suffering and sorrow, all things considered, should vastly exceed that of pleasure or happiness. The world of men and animals, says von Hartmann, a disciple of Schopenhauer, may be represented by a picture of one animal devouring another; and, he adds, *the pleasure of the eater is never so great as the pain of the one that is eaten.*

The world is so bad, then, according to the philosophical pessimist, that a benevolent spectator would pronounce it unworthy of existence. If he only had the power to do so, he would bring the pitiful drama to a close. Just as a kind-hearted man might kill a torn and mangled squirrel or rabbit in order to put it out of its misery, so the altruistic pessimist, if he saw any prospect of success, would strive with might and main to bring about a complete cessation of consciousness.

Criticism of the Pessimistic Position.—In so far as Schopenhauer's conclusion that there is a surplus of pain in the cosmos is based upon empirical considerations it is exposed to the criticism (1) that, in the nature of the case, it is impossible to make the induction sufficiently complete to be conclusive; and

(2) that, even if we should grant that there has been more pain than pleasure in the world, it need not be admitted that this will always be the case. Indeed, it may plausibly be maintained that in the earlier stages of evolution the human race was in a "pain economy," [1] but that with the advancement of civilization it has entered into a "pleasure economy."

Schopenhauer, however, seeks to reinforce his argument by a process of *a priori* reasoning concerning the nature of pleasure and pain. He maintains not only that there is a surplus of pain over pleasure, but that, in the very nature of the case, it is inevitable that there should be.[2] This *a priori* argument, upon the plausibility of which Schopenhauer's pessimistic doctrine depends, may be summarized as follows:

The Negativity of Pleasure.—*All desire is pain, and all pleasure is but the satisfaction of desire; therefore all pleasure is but the absence of pain.* This is the famous Schopenhauerian doctrine of the "negativity of pleasure." Pleasure is not regarded as a positive reality; but on the contrary, inasmuch as pleasure is but the satisfaction or temporary quieting of pain, it is pain which is to be regarded as the normal or usual condition of all sentient beings.

However plausible the reasoning may seem to be, when the argument is tested by the rules of the syllogism it is found to be fallacious. For the principal word of the apparent middle term, the word "desire," is ambiguous. In one premise it seems to imply consciousness; in the other it does not. If by desire we mean a consciously experienced need, we may perhaps grant the truth of the first premise; but if this interpretation be accepted, the second permise would not be true; for it is obvious that we experience many satisfactions which are not preceded by a conscious experience of need. On the other hand, if the word "desire" is understood to mean any sort of need, want, or lack,

[1] Cf. Patten, S. N., *The Theory of Social Forces*, 1896, pp. 59 ff.

[2] In these discussions, "pain" is not understood to be a *sensation* coördinate with contact, warmth, etc.—as is the prevailing usage of the term among contemporary psychologists—but an affective experience, the opposite of pleasantness.

whatsoever—whether the subject is aware of it or not—in this case the second premise might indeed be true, but the first would manifestly be false; for in summing up the pains and pleasures of the cosmos, it would be misleading to speak of an unconscious lack as a pain.

In short, the conclusion that pleasure is but the negation of pain would follow only on the condition that we grant the existence of pains which are not felt; but a pain that is not felt, unless we insist upon playing fast and loose with the terms of ordinary discourse, can not be regarded as a pain at all.

The Possibility of Happiness.—To approach the problem from a slightly different point of view, we must insist that the total affective tone of a given moment of consciousness is not necessarily unpleasant even if this moment of consciousness includes an unsatisfied "desire." For some other desire may be in process of satisfaction, and may determine the total affective tone of the moment. Schopenhauer's argument proceeds, however, as if there could be but *one* desire or need at a time.[3] As a matter of fact, we have many needs at once, of some of which we have no consciousness at all, and of others but a vague or dim consciousness. (See pp. 377 f.)

We are thus capable of many simultaneous satisfactions; and by directing our attention to the desires that are being satisfied and paying as little attention as possible to the others, one is usually able to have a total affective tone which is predominantly pleasant. Bearing in mind this fact of our psycho-physical constitution, we may even venture to suggest *a rule* for the attainment of a maximum of pleasure with a minimum of dissatisfaction. This rule is twofold:

(1) Have the greatest possible number of interests, needs, or latent desires of the sort that are reasonably certain to be satisfied rather frequently and without undue delay.

(2) Attend, so far as possible, to those that are in process of satisfaction.

[3] Cf. Ward, L. F., *Pure Sociology*, 1903, pp. 102 ff.

3. Optimism and Meliorism

Having seen that the pessimists' doctrine, that the cosmos is predominantly evil, is without a rational foundation, let us now examine the doctrine of the optimists. Philosophical optimism has already been defined as the theory that this is the best of all possible worlds. (See p. 405.) The optimist does not deny the obvious fact that evil exists; but he contends that evil is a necessary condition of the highest types of good. For example, he points out that in a world which would contain no danger, there could be no courage; in a world without pain, there could be no patience; in a world without sin, there could be neither repentance nor forgiveness. Suffering, he maintains, is chastisement; and for all ills there is compensation.

The Best of All Possible Worlds.—In short, the optimist insists that this actual world of ours, with all its sins and sorrows, is better than it would be if it were entirely free from evil. Indeed, he maintains, at least by implication, that this world is better than it would be if it contained either more or less evil than it actually does contain; for, if this is the *best* of all possible worlds, all of the evil which exists must be required, to produce the perfect Whole. Just as in a picture the beauty of the whole requires that there shall be portions which are shaded as well as portions which are bright, so in order that the universe considered as a whole may be perfectly good, some parts of it must be evil.

> Better for us, perhaps, it might appear,
> Were there all harmony, all virtue here;
> That never air or ocean felt the wind,
> That never passion discomposed the mind.
> But all subsists by elemental strife;
> And passions are the elements of life.
> The gen'ral order, since the world began,
> Is kept in nature, and is kept in man.
>
> . . . . .
>
> All nature is but art, unknown to thee;
> All chance, direction, which thou canst not see;

> All discord, harmony not understood;
> All partial evil, universal good.
> And, spite of pride, in erring reason's spite,
> One truth is clear, 'Whatever is, is right.'[4]

Meliorism.—In consequence of its emphasis upon the Whole, optimism is allied with singularism. (See Chap. XII.) As we saw, however, in our discussion of that topic, any theory which merges all things and persons in the One, must, if it is developed consistently, deny the significance of human effort and the reality of progress. Optimism holds that the universe is good, that what we call evil is an essential ingredient in the perfection of the Whole. But if the universe is already perfectly good, why try to make it better? If this world, as it is to-day, is the best of all possible worlds, is it not to be feared that in our zeal for improvement we shall make it worse? If it be true that the beauty of the picture requires the precise number, size, and shading of such darker portions as now exist, is there not danger lest in trying to brighten our corner of the universe we spoil the beauty of the whole?

As viewed by the philosophical optimist, the world is so thoroughly good that there is no room for improvement; the pessimist, on the other hand, maintains that it is so thoroughly bad that there can be no reasonable hope of improvement. In opposition to both of these positions, the *meliorist* contends that the world is neither perfectly good nor hopelessly bad, but that it is possible to make it better.

James versus Royce.—The optimist, as we have seen, maintains that all which finite selves experience as evil would be found, if we could see the universe from the standpoint of an omniscient observer, to contribute to the perfection and felicity of the Absolute. Optimism, accordingly, is singularistic. Meliorism, on the other hand, allies itself with pluralism; for the meliorist contends that finite selves are independently real, and that what we experience as evil *is evil* and nothing else.

[4] From Pope's *Essay on Man.*

A generation ago these rival points of view found representatives in American philosophy in the persons of Josiah Royce and William James. The former stood for idealism, singularism, and optimism; the latter for realism, pluralism, and meliorism. In the final analysis, the difference between the points of view of these eminent philosophers is found to consist in a difference in the appraisal of values. Royce maintained that in order that the whole may be perfect it must contain some evil; for the highest moral good, he said, presupposes the *overcoming* of evil.[5] This doctrine—at any rate, when combined with the view that the Whole is a *self*—was found by James to be intellectually impossible. "My conclusion," he writes, "is this, that although the hypothesis of the Absolute, in yielding a certain kind of religious peace, performs a most important rationalizing function, it nevertheless, from the intellectual point of view, remains decidedly irrational. The *idcally* perfect whole is certainly that whole of which the *parts also are perfect.* . . . The absolute is defined as the ideally perfect whole, yet most of its parts, if not all, are admittedly imperfect. Evidently the conception lacks internal consistency, and yields us a problem rather than a solution. It creates a speculative puzzle, the so-called mystery of evil and of error, from which a pluralistic metaphysic is entirely free." [6]

May a Perfect Whole Include Parts which Are Imperfect?—Unfortunately we do not find ourselves in complete agreement with either of these distinguished thinkers. We have already argued (see Chap. XII) that the conception of the Absolute, as defined by Royce, is logically and psychologically impossible; and that if it were taken seriously it would negate the idea of progress and thus cut the nerve of human endeavor.

On the other hand, it hardly seems possible to accept James's axiom that "the ideally perfect whole is certainly that whole of

[5] Cf. *The Religious Aspect of Philosophy,* 1910, pp. 454 f.; *Sources of Religious Insight,* 1912, pp. 224 and 237; *Studies of Good and Evil,* 1898, *passim.*

[6] James, Wm., *A Pluralistic Universe,* 1909, p. 123.

which the parts also are perfect." One might as well say that the parts of a perfect sphere must themselves be spherical; or that the factors of a composite number must themselves be composite. Indeed, it seems to be an obvious fact of human experience that evil is sometimes the indispensable condition of a greater good. We need only remind ourselves of the joys of overcoming, and of the common experience that *earned* satisfactions are more intense and more lasting than those which come without labor. To return to the phraseology employed in Chapter XIII, the net worth of a state of affairs which contains both satisfactions and denials of satisfaction may very well be greater than it would be if it contained no denials of satisfaction whatsoever. This follows from the circumstance that, in some cases, a denial of satisfaction is the indispensable condition of two or more satisfactions, or, it may be, of some one satisfaction which is of much greater intensity and duration.

Even a pluralist, it seems to me, must admit that the universe is better than it would be if it contained no evil at all. Nevertheless there is no reason to believe that the amount of evil now existing is the exact amount required to make a perfect world; or indeed that the world as it now exists is perfect. Accordingly men of good-will need not scruple to diminish the evil of the world as much as possible. We may rest assured that, after we have done our best, enough evil will still remain to furnish occasion and opportunity for the manifestation of goodness. It is obvious, indeed, that a world utterly devoid of evil is a psychological impossibility; for such a world would be horribly monotonous, and monotony is itself an evil. Moreover, as long as the human mind remains both finite and curious, the evil of *ignorance* will remain as a spur to heroic endeavor.

Is Good-Will Omnipotent?—Men of good-will need have no fear, then, that they will make the world worse through their success in making it better! Indeed there is no present danger that human existence will become spiritually impoverished for lack of even the more obvious evils. For famine, disease, premature death, war, crime, earthquakes, volcanic eruptions, hurri-

canes, destruction wrought by lightning, explosions in mines, the mangling of human bodies by machines, and last but by no means least the meanness, cantankerousness, dishonesty, drunkenness, impurity, and insanity of human beings—all these, and many other forms of evil, still remain and, it is to be feared, will long remain, as a standing challenge to such good-will as there is to work for their removal.

Indeed, the existence of evil creates an insoluble problem, not only for optimistic philosophy but also for traditional theology with its doctrine of the divine omnipotence. For, if God is omnipotent, why does He permit men and little children to die of cancer, cerebrospinal meningitis, and other horrible diseases? Why does He permit earthquakes and volcanic eruptions to snuff out the lives of men, women, and children by the thousands, as if they were so many ants or flies?

"But," it is said, "all these things are for wise and good ends." It may be contended that "we do not know what wise reasons the Omniscient may have had for leaving undone things which He had the power to do. It is not perceived that this plea itself implies a limit to Omnipotence. When a thing is obviously good and obviously in accordance with what all the evidences of creation imply to have been the Creator's design, and we say we do not know what good reason He may have had for not doing it, we mean that we do not know to what other, still better object—to what object still more completely in line with His purposes, He may have seen fit to postpone it. But the necessity of postponing one thing to another belongs only to limited power. Omnipotence could have made the objects compatible. Omnipotence does not need to weigh one consideration against another. . . . No one purpose imposes necessary limitations on another in the case of a Being not restricted by conditions of possibility." [7]

God, then, according to John Stuart Mill, William James, and others who are impressed by the logical incompatibility between the conceptions of omnipotence and goodness, must be thought

[7] Mill, J. S., *Three Essays on Religion*, 1874, pp. 179 f.

of as *finite*. But, say the critics of this doctrine of a finite deity, it is absurd to speak of God as finite! For the very definition of deity includes the idea of infinity—infinity of power, infinity of knowledge, infinity of love. Yes, replies the finitist, but in that case your definition is self-contradictory! If we would save the infinity of power, we must give up perfection of goodness; and if we would save the perfection of the divine goodness, we must give up the infinity of divine power.

Now some persons, without, I suspect, being fully aware of what they are doing, seem to have chosen the former of these alternatives. They begin with the assumption that it is of the essence of deity to be omnipotent, to be completely sovereign; and from this they infer that everything which is or takes place is right. But this, if carried through consistently, would completely empty the doctrine of the divine goodness of all human significance. For this conception would make the divine will completely arbitrary, and therefore non-moral. It reminds us of the ideas entertained by Browning's Caliban concerning his god Setebos:

> 'Thinketh such shows nor wrong nor right in Him
> Nor kind, nor cruel: He is strong and Lord.
> 'Am strong myself compared to yonder crabs
> That march now from the mountain to the sea;
> 'Let twenty pass, and stone the twenty-first,
> Loving not, hating not, just choosing so.
> 'Say, the first straggler that boasts purple spots
> Shall join the file, one pincer twisted off;
> 'Say, this bruised fellow shall receive a worm,
> And two worms he whose nippers end in red:
> As it likes me each time, I do: so He.[8]

Suppose, however, postponing for the moment the problem of the definition of deity (see pp. 415 ff.), we simply ask the question, Is there, either within the universe, or outside the universe but acting upon it, *a Good-Will which is all-powerful?* It seems clear to me that this question must be answered in the negative.

[8] Browning, "Caliban upon Setebos; or Natural Theology in the Island."

Good-Will would find a cure for cancer, would have found it a thousand years ago; but the cure does not seem as yet to have been discovered. Good-Will would have all children born with healthy bodies and good minds; every now and then, however, some mother gives birth to a hunchback, to a two-headed monster, to an idiot. Good-Will would save men from useless pain; but men die in agony, torn by wild beasts, poisoned by pathogenic bacteria, scorched by flaming gas, or crushed by falling rocks and timbers. Thus we might continue our enumeration of the thousand and one evils which Good-Will must certainly wish to remove or prevent, but which have not thus far been removed or prevented. The simplest explanation of these facts of human experience is to say that Good-Will is not omnipotent, is not able to do all that it wishes to do.

It does not help the defender of omnipotence in the least to suggest that Good-Will has other and greater purposes to subserve, and for that reason does not do or prevent these things; for, as is brought out with crushing clarity by Mill in the passage quoted above, "the necessity of postponing one thing to another belongs only to limited power." Again it does not help in the least to suggest that Good-Will is sure to triumph over all evils in the long run. This may well be true; we hope, indeed, that it is true. But this, too, is but another way of saying that here and now the power of Good-Will is limited.

4. A Doctrine of God

It is manifest that the belief in progress is closely bound up with religious and theological ideas. And we shall accordingly conclude this chapter with some suggestions toward the formulation of a doctrine of God which is compatible with modern science and philosophy. Our thought will be dominated by the idea of a progressive attainment of human values; and the doctrine suggested will be that God is to be thought of as Good-Will—but as a Good-Will which, as we saw in the last paragraph, is not omnipotent.

Before developing this doctrine of God as Good-Will, it may,

however, be helpful to give a brief outline of traditional theories:

THEISM { POLYTHEISM; HENOTHEISM; MONOTHEISM { DEISM; PANTHEISM; THEISM }

In this diagram, it will be noticed that the term *theism* is employed in two different senses. In its broader meaning it denotes any theory of supernatural agency, any doctrine of God or of the gods whatsoever. In its narrower signification, it is a variety—a very important variety—of *monotheism.*

Monotheism is, of course, as the word itself suggests, the doctrine that there is but one God; while *polytheism* is a doctrine of many divine beings. Our other principal theological doctrine, *henotheism,* may be thought of as a position intermediate between monotheism and polytheism. The henotheist recognizes the existence of many gods; but is himself loyal to only one. It is probable that the henotheistic belief was earlier than either of the others. According to this view, polytheism may have arisen —as, for example, among the classic Greeks and Romans— through the enforced amalgamation or voluntary alliance of originally independent groups, in consequence of which the members of each group came to accept the gods of all the others; while monotheism would develop out of the earlier henotheism when men became convinced that their god was the only God, and that all the other so-called gods were either evil spirits or purely imaginary beings. The latter seems to have been the course of development among the ancient Hebrews. Among thinkers who are more tolerant and philosophic than the ancient Hebrews, monotheism may also appear as the insight that all of the supposedly different divine beings of the henotheist or the polytheist, such as Zeus, Jupiter, Jehovah, Chemosh, Osiris, Wodin, etc., are in reality but different names for the one true God.

Turning now to the varieties of monotheistic belief which are included in our diagram, *deism* may be described as a doc-

trine which affirms that God exists, that He created the world, and that He promulgated the moral law; but which minimizes, or denies altogether, His present activity. As some wag has put it, God created the world, and "then retired to private life." In other words, deism emphasizes the conception of the divine transcendence. *Pantheism,* on the other hand, lays stress upon the conception of the immanence of God, teaching that God dwells in the world, or even that He *is* the world. In the light of its etymology, pantheism may also be defined as the doctrine that God is all and that all is God.

Historically the distinction between deism and pantheism was not so clear-cut as we have represented it; for in the seventeenth and eighteenth centuries the name "deism" was given to a wider movement of thought which denied, or minimized the importance of, miracle and "special revelation," and attempted to substitute "natural" for "revealed" religion. Instead of finding God in a book, it sought to find Him in man and in external nature. Thus historic deism tended in some of its representatives to pass over into pantheism, the doctrine that God is indistinguishable from the universe.

Theism, the form of monotheism which has been defended by "orthodox" Christian, Jewish, and Mohammedan theologians, attempts to include the truth and avoid the error of both deism and pantheism. Theism, accordingly, does not regard the conceptions of transcendence and immanence as mutually exclusive; but insists that it is the transcendent God who is immanent and the immanent God who is transcendent.

Does God Exist?—Whether this reconciliation of the conceptions of transcendence and immanence can ever be more than a verbal compromise, we need not here inquire; for it is clear that historic theism, in its dread of pantheism, has always made more, in actual practice, of the idea of transcendence than it has of that of immanence. And it is the emphasis upon transcendence which makes the traditional God-concept difficult for one who is imbued with the spirit of modern science and philosophy. For in the degree in which God is assumed to be separate and

different from the world and from man, in that same degree His existence becomes incapable of demonstration.

It is impossible, of course, to prove that a transcendent deity does *not* exist—just as it is impossible to disprove the existence of a dozen or of a thousand divine beings; but as students of philosophy we cannot content ourselves with a mere *argumentum ad ignorantiam* in behalf of theological beliefs, when in all other matters we demand positive evidence.

A Doctrine of Partial Immanence.—If we are to retain the God-concept, we must then think of God as *immanent*. But in view of what was said above about the problem of evil (see p. 413), God cannot be thought of as immanent in everything. As James well says,[9] " 'God,' in the religious life of ordinary men, is the name not of the whole of things, heaven forbid, but only of the ideal tendency in things, believed in as a superhuman person who calls us to coöperate in his purposes, and who furthers ours if they are worthy. He works in an external environment, has limits, and has enemies."

So much truth there is, then, in the traditional idea of transcendence; we cannot simply identify God with reality as such. Accordingly, the doctrine of God which I am suggesting may be thought of as a doctrine of *partial immanence*. If God is to be thought of as good, He cannot be identified with the whole cosmos, but only with so much of it as possesses moral worth. To be sure, the assumption that God is good might be abandoned, and the term God might then be used as a name for all reality, or for that part of reality which is believed to dominate and control the rest. Since on this theory all power would be included in God by definition, He would of course be omnipotent; but He would not be perfectly *good*.

God as Good-Will.—In framing our conception of deity it is necessary, then, to make our choice between the idea of *power* and the idea of *goodness* as the fundamental element of our definition. If, for example, we should say that God is "the eternal and everywhere present Energy by which all things are

[9] *A Pluralistic Universe*, 1909, p. 124.

produced," we cannot escape the difficulty that this cosmic Energy produces the evil and the ugly, as well as the beautiful and the good. If God is energy, then energy is God; and there is no sufficient reason why energy should be worshipped. The only thing which can be reverenced without qualification is goodness or love.

Thus in our search for a satisfactory account of the God-concept we are reminded of the scriptural statement that "God is love." To be sure, we cannot simply appeal to this as a "proof-text" upon which to ground the doctrine of God which we are about to suggest; for it is not likely that the writer of I John 4:8 meant this statement to be taken as a definition of God, but only as a rhetorical statement of an essential attribute of deity. Let us, however, regard it as a definition. *God is love* and *love is God.* "Where love is, there God is too," said Tolstoi. Everyone is God in so far as his behavior is controlled by love.

"Love," however, is a word of many connotations. It is obvious that in identifying the divine in each of us with love, we are not thinking chiefly or specifically of biological love; although it is worthy of remark that when a person, as the saying is, "falls in love," he does in some measure fall out of selfishness. Neither by "love" do we mean mere sentimental affection; but rather benevolence or good-will. God is then Good-Will; and wherever Good-Will is, there God is too.

But Will, too, as we saw above (see p. 405), is an ambiguous word; and the phrase Good-Will must of course share in this ambiguity. If the term Will is understood to mean any kind of striving or tendency whatsoever, whether or not there is assumed to be a prior knowledge of the goal whither the process tends, then every process which, as a matter of fact, produces a surplus of satisfactions would be an element of Good-Will. From this point of view we might accordingly identify God with the "Life-Force," or the Bergsonian *élan vital.*[10]

This notion of "Life-Force" or *élan* is, however, exceedingly vague; and if we define God as the Life-Force, we are in

[10] Cf. Reeman, E. H., *Do We Need A New Idea of God?* 1917.

danger of falling back, before we know it, into those ideas of God as Cosmic Energy or Fundamental Reality which we have already examined and found unsatisfactory. It seems better, then, in order to steer clear of these abysmally vague conceptions of deity, to restrict the denotation of the term Will to *conscious* purposiveness; and that of Good-Will to such strivings as are consciously directed toward the production of value. When we say that God is Good-Will, our meaning is then that the term God is a name for the sum-total of all good intentions, all worthy ambitions, all noble aspirations, all altruistic endeavors, all generous strivings after goodness, beauty, or truth.

The Question "Whether?" and the Question "What?"—There are two ways of approaching the God-problem: we may ask the question "Whether?" or we may ask the question "What?" Each question as ordinarily understood implies an assumption. If we ask *whether God exists,* we take it for granted that we have already given a definite meaning to the word God. On the other hand, if we ask *what God is,* it is natural (even if it is not in strict logic necessary) to understand that God is assumed to exist, and that we are only seeking to determine what meaning can be given to the term God, in the light of contemporary science and philosophy.

A century ago it was the question "Whether?" which was the more frequently asked. Theists and atheists alike took it for granted that everybody knew the meaning of the term God, and that the only question to be considered was whether or not there *is* a God. Thus they usually contented themselves with marshaling the arguments for and against the existence of a transcendent deity. If we have the patience to reread these old debates, we cannot help feeling that the atheists often had the better of the argument. Now, however, there are very few people—outside of Russia, at least—who call themselves atheists. For, instead of fixing upon some hard-and-fast definition of deity, and then raising the question, "Does God exist?"—a procedure which would, as likely as not, lead us to a negative conclusion—we prefer to ask, "In what kind of God is it reasonable for us to

believe?" In other words, we try to frame our definition of God in such a way as to make belief possible.

If now we define God as the Good-Will of the cosmos, if we say that every manifestation of Good-Will is a manifestation of God, there can be no doubt of God's existence. For we all know of persons whose purposes we believe to be good; and even in those whom the world calls bad, we now and then discover at least occasional flashes of noble endeavor; while most of us, if we are honest with ourselves, must admit the existence of some glimmerings of Good-Will even in ourselves! No longer able to find God beyond the stars, we may discover Him by looking within—we may find him in ourselves and in our neighbors.

Is the Universe Friendly?—Our belief in God's existence is, then, in the last analysis, a belief in the reality of love. Just how much love this universe contains, just to what extent the universe is controlled by love—these are questions concerning which we need be in no hurry to commit ourselves. It would be very pleasant to believe that the universe, considered as a whole, is friendly; but candor bids us confess that we know nothing about the universe considered as a whole. Indeed, it may well be doubted whether there is any mind which is able to consider the universe as a whole; or whether there is any significant sense in which the universe is a whole rather than an aggregate of independent reals. Thus our theism is very modest. Instead of asserting that *the universe is friendly,* we content ourselves with the obvious truth that *there is friendliness within the universe.*

It is true that our belief in progress requires us to assume something more than this. In order to justify our belief in progress, it is necessary to postulate that there is *sufficient* friendliness, sufficient interest in the production of values, to bring about a gradual increase of good. But here we walk by faith, not by sight. That there is good-will in the universe is a mere matter of observation; that, in the past, there has been sufficient good-will to make the world gradually better is an inference which seems to be justified by the relevant facts; but that there *will* be sufficient good-will to ensure this progress in the future,

is at most a postulate which ought to be affirmed, but which cannot be demonstrated.

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CHAPTER XV

CONCLUDING REFLECTIONS

1. The Life of Thought and the Life of Action

One of the advantages of the doctrine of a finite deity is that it leaves room for genuine activity on the part of human beings. We cannot excuse our idleness or our indifference to good causes by pleading that sin and suffering are eternally necessary to the perfection and maximum felicity of the Absolute, or by suggesting that the Omnipotent One will remove all evils in His own good pleasure; but we are challenged to coöperate with God, the Good-Will of the universe; for according to the hypothesis which we have adopted, He needs our help.

Coöperation with Cosmic Goodness.—Effective coöperation with the Good-Will of the universe depends, however, upon a knowledge by us of what is really good. "The road to hell is paved with good intentions"; and many a man has labored with exemplary zeal and devotion for the accomplishment of purposes which, as we now see, could not have been fulfilled without great detriment to the well-being of humanity. Depending upon conscience, upon reason, upon "infallible" authority, these men have been honestly mistaken. What assurance can we have that we too are not mistaken in our choice of the causes and movements to which we have given our allegiance?

Our Inability to Foresee All the Consequences.—Suppose we accept the consequence criterion. Let us assume that the rightness or wrongness of an act depends upon the consequences which may reasonably be expected to flow from it. But what are the consequences? In many cases, it must be admitted, it is very hard to say. For example, to apply our criterion—which, as we

argued in a previous chapter (see pp. 386 ff.), is the best that we have—to a problem of statecraft, was it right for President Lincoln and his associates to employ armed force in order to maintain the American Union? He believed that it was right; indeed, he believed that it was his supreme duty to do so—a duty to which everything else was to be subordinated. I am inclined to think that he was right; but to be absolutely certain, one should have had to take account of *all* the consequences; and to do this it would have been necessary to peer farther into the future than he was able to see—farther, indeed, than we are even now able to see.

To take another example of the difficulty of applying the consequence criterion, we may consider the case of the League of Nations. Some of us believe that it will prevent wars and bring in an era of peaceable adjustment of such differences of national purpose as may hereafter arise. And yet can we be perfectly sure that on the whole and in the long run the formation of the League of Nations will be found to have been for the greater good of humanity? Suppose that the present rather ineffective organization should eventually develop into a centralized World State, and that the men in control of this World State should then decide to crush out all national and individual differences. In that event, would not the last state of the human race be worse than the first?

Now I believe that Lincoln was right, and that our contemporary advocates of the League of Nations are right; but in neither case can my belief be supported by an absolutely cogent argument. In these cases, as so often in the crises of human history, action must outrun knowledge; for decisions are forced upon us long before it is possible to know for sure what even a tithe of the consequences will be.

The Alleged Incompatibility of Thought and Action.—Here, then, we are confronted by a dilemma. On the one hand, we have insisted that the scientific method of hypothesis ought to be carried into all fields of investigation; and that as scientists and philosophers we have no right to believe, no right to make

up our minds, without sufficient evidence to convince the reason. On the other hand, as we have just pointed out, the man of action is frequently obliged to believe, to commit himself to some cause, movement, or policy, before the evidence is all available. We must accordingly face the question whether there is not an insuperable opposition between the life of thought and the life of action. Can the same individual be both a scientist and a man of affairs? Or must the thinker always be ineffective as a doer, and the practical man always indifferent to and contemptuous of the problems of pure science and philosophy?

The Possibility of Shifting from One Attitude to the Other.—In short, it seems to be a question of two incompatible habits. Whatever position we may take in regard to the general problem of the "transfer of training," there is considerable evidence for the belief that there is a spread of habits, attitudes, and ideals from one field of activity to another. It seems probable, then, that the habit of logical caution which scientists and philosophers tend to form in their laboratories and studies will be carried over into their activity—or lack of activity—in other departments of life. Thus there is a very real danger that action may be "sicklied o'er with the pale cast of thought." The "open mind" may become so completely open that the man becomes incapable of any settled beliefs or convictions whatsoever.

It must be admitted, I think, that the tendency exists. Yet a further consideration of the problem of transfer of training leads to the conclusion that habit formed in one field of activity *need not* interfere with activity of a different type. All that is necessary to prevent such interference is that there shall be sufficient practice in both types of activity to permit a ready transition from one to the other. We are reminded of Münsterberg's famous experiment with his watch. He "carried his watch in a pocket other than the usual one, and noted the number of times he sought it in the old place before he acquired the correct habit. Then returning it to its former position he gradually regained the first habit, though with occasional mistakes. Repeating the performance several times, he discovered that the

number of errors rapidly grew less, until at length the initial act and mental 'set' or direction sufficed to call the right mechanism of habit into play." [1]

It is not impossible, then, for the scientifically trained man, if he will, to avoid transferring the habit of caution and postponement into fields where prompt decision is required. As the practiced linguist changes from one set of verbal associations to another, and the skilled chauffeur from one type of "gear shift" to another; so the man of thought may learn to change at will from one mental attitude to another. In a word, it is not impossible for the same individual to be both a man of thought and a man of action.

The Scientifically Trained Man's Right to Believe.—It may be objected, however, that although such a change of attitude may be psychologically possible, it is not ethically justified. And the man of thought may accordingly refuse, as a matter of principle, to have anything to do with contemporary issues. He may hold that by entertaining convictions which are not rationally grounded a man would destroy his intellectual integrity; and that it is impossible to find sufficient evidence to justify opinions on current political, economic, or religious questions in the manner in which the opinions of a philosopher ought to be justified. We cannot help respecting one who consistently and sincerely maintains this point of view; but we must also admit that it is unfortunate for him to remain aloof from vital human action and discussion.

Our Right to Disregard the More Remote Consequences.—There are several considerations which may well be brought to the attention of one who, as a matter of principle, declines to make any decision concerning contemporary human problems.

In the first place, we may urge that in applying the consequence criterion, we may simplify our problem by basing our decision upon a consideration of the *proximate* results of a proposed course of action, to the neglect of consequences which are more remote. (See p. 378.) Thus in deciding what attitude

[1] Ewer, B. C., *Applied Psychology*, 1923, p. 169.

we ought to adopt toward the League of Nations, or any other contemporary "cause" or "movement," we may disregard considerations which are so remote that it is impossible for us to know anything about them. We are justified in assuming, in the absence of any evidence to the contrary, that if the effect bids fair to be predominantly good for the next fifty years, it may reasonably be expected to be good for the next five hundred years; and if it bids fair to be good for five hundred years, we may fairly assume that it will be good for five thousand.

If it be objected that we have no right to neglect the remote consequences of proposed courses of action, we may permit ourselves the luxury of a *tu quoque*. We may point out that the scientist himself is constantly doing something of very much the same sort. For all scientific explanation is based upon the necessary postulate that observable relations constitute a trustworthy index of relations which are beyond our power of observation. Thus the total cause of any given event is the state of the entire universe at or just before the time of its occurrence; or, if this would take us farther than we are willing to go in the direction of a singularistic view of the cosmos, we must at least admit that the cause of any given event is likely to include factors which are so remote in space, and perhaps also in time, as to be entirely beyond our ken. For example, the astronomer in determining the motions and positions of the planets finds it necessary to disregard the gravitational influence of all but a few of the nearest heavenly bodies. In the same way, the chemist and the physicist in explaining the changes which take place in their laboratories necessarily disregard the effect of processes occurring on other planets. Thus, too, in arriving at decisions concerning "practical" matters, we are justified in evaluating the consequences which we cannot foresee in the light of those which we can.

Cases in which Belief Contributes to Its Own Fulfillment.—In the second place, we may remind the man who has scruples about committing himself to hypotheses of a practical kind that *belief sometimes contributes to its own fulfillment*. As

James well says,[2] *"Where faith in a fact can help create the fact,* that would be an insane logic which should say that faith running ahead of scientific evidence is the 'lowest kind of immorality' into which a thinking being can fall. Yet such is the logic by which our scientific absolutists pretend to regulate our lives!"

There are many obvious illustrations of the truth that "faith in a fact can help create the fact." For example, if a boy believes that he can jump over a ditch, he is much more likely to be able to do so than he would be if he did not have this faith; or if a person believes that he is going to get well, he is more likely to recover than he would be if he were convinced that his disease is incurable.

On the other hand, it is manifest that this principle can easily be carried too far. If the ditch is too wide, the small boy's confidence may lead to disaster; and if the disease is really serious, the patient's faith in the curative power of nature or of prayer may prevent the calling of a physician until it is too late. Yet it is equally clear that, where our choices and attitudes are important factors in producing the result, it is foolish to refuse to believe.

Cases in which Decision Is Unavoidable.—Finally, in appealing to our scientifically trained man to commit himself to such causes and movements as seem to him to be worthy, we may urge that the conditions of choosing are different in the case of *actions* from those which obtain in the case of *theories*. The difference is, that in theoretical matters there are *three* possible positions—affirmation, negation, and refusal to decide; while in practical matters, there are only *two* positions—doing the deed, and not doing it. As James puts it, our choice in practical matters is a "forced option"; for a refusal to decide is itself a decision. Inasmuch, then, as we are obliged to decide one way or the other, it follows that in such cases we are justified in acting as if we had more knowledge than has been scientifically verified.

[2] *Will to Believe,* 1897, p. 24.

We must however be on our guard against misunderstanding if we speak, as James does in his essay entitled *The Will to Believe,* of "believing" something which cannot be scientifically established. For the word "believe" is ambiguous: it may mean (*a*) to give *intellectual assent* to a proposition, or (*b*) *to act* as if we knew the proposition to be true. And it is important to observe that belief may be present if the phrase "to believe" be taken in the latter sense, and at the same time absent if it is understood in the former. For it is clear that the will-to-act-as-if may very well co-exist with the will-not-to-commit-one's-self-intellectually.

In other words, concerning one and the same issue there may be a forced option *practically,* and no need of coming to a decision *intellectually.* Thus a parent may be said to believe practically that his son will be alive twenty years from now; for he is spending thousands of dollars in helping him to prepare for a profession. He acts as if he knew the future. Intellectually, however, the parent believes nothing of the kind; for he will frankly admit, if he is challenged, that he does not know what the morrow will bring forth.

Accordingly, if James's "will to believe" is to be a defensible concept, it must be interpreted as the will to act; the willingness, in popular speech, "to take a chance." And if we may venture to criticise James's position, we may suggest that he is not sufficiently clear in regard to this possibility of refusing to believe (intellectually) for want of sufficient evidence, and of being willing at the same time to believe (practically) in the sense of being willing to act as if the thing were known to be true. Thus James contends that "Our passional nature not only may, but must, decide an option between propositions, whenever it is a genuine option that cannot be decided on intellectual grounds." He seems to forget that in pure science there are no forced options; the question can simply be left open. Indeed, whenever the issue is such that it cannot be decided on purely intellectual grounds, the scientist, *as scientist,* simply reserves decision; while, *as man,* the very same person may be willing

to stake his life on the chance that a given answer will be found to be true.

2. Science and Religion

In the preceding section we have in effect been discussing a phase of the celebrated "conflict between science and religion." For if we may characterize religion as *enthusiasm for the good,* and science as the *demand for evidence,* the two attitudes do seem to be contrary one to the other. How indeed can one be enthusiastic about the good until he has determined what really *is* good? But in all inquiries concerning the right, the good, or the true, the tendency of science is toward the open mind; the scientist regards all theories as hypotheses, which are to be superseded or modified as newly discovered facts may require. The attitude of religion, on the other hand, is not perhaps that of the closed mind, but, at any rate, it is that of the satisfied mind.

It must be admitted, then, that there is a real incompatibility between the attitude of science and that of religion. The mental habit of the typical research man is different from that of the prophet of righteousness. We have already suggested, however, that this incompatibility, while real, is not absolutely unavoidable. It is not impossible to combine, or at any rate to alternate between, the two attitudes. A stern refusal to accept a proposition as scientifically verified may co-exist in the same mind with a willingness to act as if it were known to be true. In other words, if religion may be defined as an enthusiasm—while science is not very favorable to enthusiasm of any kind, and while we must recognize a natural and actual opposition of attitudes—it is not absolutely necessary that there should be a conflict between science and religion. We may add, indeed, that there are two unverified and unverifiable ideas which even the typical scientist accepts, and which arouse in his breast a quasi-religious devotion: these are, first, the value of the *truth* which he seeks, and, secondly, the trustworthiness of the *method* by which he seeks it.

Religion as Acceptance of Theology.—Usually, however, when men speak of a conflict between science and religion, they are thinking neither of religion as an enthusiasm nor of science as a method, but of both as systems of doctrine. Thus regarded, the two are undeniably in conflict. And especially in Christendom the warfare of science with theology has been, and still is, a melancholy fact of human history. In this warfare, science has for the most part been victorious. One after another of the intrenchments erected by the theologians has been captured; the frontiers of "religion" have been pushed back farther and farther. The worst feature of this persistent conflict is that each party to the combat has received wounds and bears scars which bid fair to be permanent. The scientist has in only too many cases acquired an unscientific anti-religious bias; while the religionist has been filled with a sense of disillusion and despair as one after another of his cherished ideas has had to be given up.

As a hint toward a way out, we may suggest that theology is itself a science; and that theological conceptions ought accordingly to be regarded as *hypotheses* rather than as *dogmas*. For if the theologians can be persuaded to substitute the experimental method for the method of authority, while there will still be plenty of room for diversity of opinion concerning specific problems, there will no longer be any room for a conflict between science and theology. One might as well talk about a conflict between science and chemistry, or science and astronomy, as between science and theology.

Religion as the Feeling of Dependence.—Religion has frequently been defined as a "feeling of dependence." That upon which one depends would then be his God. And the various religions would differ from each other in accordance with their conception of the manner in which the events and processes in which men are interested are produced and controlled. If religion is defined in this way, while there may at any given stage of human advancement be a conflict between the results achieved by science and some particular religion, there

can be no conflict between science and religion as such. Science cannot destroy or oppose religion; the most that it can do is to modify religion by changing man's conception of that upon which he feels himself to be dependent.

Thus there was a time when most men felt themselves to be dependent upon a multitude of gods or spirits. To-day, in civilized countries, this kind of feeling of dependence has been superseded to a greater or less degree by a sense of dependence upon "nature," upon one's fellow-men, and last but not least, upon machines of man's contriving. The goods which men seek are pretty much the same as ever; but the way of seeking them is different. Men now depend much more, if we may judge from their behavior, upon the physician, the chemist, the plumber, and the garage-man than upon the priest; upon drugs, vaccines, electricity, and gasoline than upon prayer, fasting, or any kind of ritualistic observance. Indeed, if religion is to be defined as the feeling of dependence, it would not be far wrong to say that, most of the time, the god of the modern man is the machine.

Religion as Enthusiasm for the Good.—Let us return, however, to the suggestion that religion should be defined as enthusiasm for the good. This suggestion is entirely harmonious with the doctrine that God is the Good-Will of the universe (see pp. 418 f.). To be sure, if religion is enthusiasm for the good, there will then be as many different varieties of religion as there are kinds of good about which men are enthusiastic. Thus the religion of one may be science; the religion of another may be athletics; that of a third, art; of a fourth, social reform; etc. Upon reflection, however, it will be seen that none of these can be regarded as more than a partial phase or aspect of a complete religion.

It is not enough, then, that the scientist and the philosopher should devote themselves to the quest of truth. They ought to train themselves so as to be able to do their part *both* as thinkers and as doers. They ought to be able, on the one hand, to maintain an attitude of logical caution, refusing to regard any hypothesis as established unless there is a clear preponderance of

evidence in its favor; and, on the other hand, to act as if they knew a great deal more than anyone can possibly know about most questions of human interest and importance.

There is, however, one qualification which ought to be made. It is doubtful, to say the least, whether we have a right to include *professions of belief* under the head of "acting as if." For to do so would be to open wide the door to insincerity and pretense. On the contrary, while investing our time and energy in working for the triumph of contemporary causes, we will say quite frankly that we do not know for sure what the ultimate outcome will be. Historically, at any rate in Christendom, there has been a tendency to exaggerate the importance of profession of belief. Faith has been identified with *intellectual assent;* and error and doubt have been regarded as mortal sins. As a consequence, men have been accustomed to make daily and weekly professions of assent to pronouncements concerning which it is manifestly impossible to obtain scientifically verified knowledge; and men who have been wavering and uncertain in their confidence in the future progress of the human race have often been the loudest of all in professing their unquestioning acceptance of the "fundamentals of the faith."

We should distinguish clearly, then, between *faith* and *the faith.* The former is essentially a willingness to venture and to adventure; the latter is a body of doctrine, belief in which has traditionally been regarded as necessary for salvation. If religion is enthusiasm for the good, it is not necessary that a person profess assent to all that was "once delivered to the saints." All that is required in order to be religious is that he shall dedicate his life to the greater good of humanity. The scientist in his laboratory who is wagering his life on the chance of adding to the sum-total of verified human knowledge; the parent who makes sacrifices in the hope that his children and his children's children will be profited by them; the citizen who employs his voice, his pen, and his vote in behalf of measures of national and international importance—these and all others who are striving for what they honestly regard as the

best and noblest things, are men of religion, exemplifying the life of faith.

3. Egoism and Altruism

If, in accordance with the suggestion made in the preceding section, religion is defined as enthusiasm for the good, it is natural to inquire for whose good one is expected to be enthusiastic. The question has often been put in this form: Am I to seek my own good, or that of others? Thus the issue has been stated as a conflict between egoism and altruism; and the bad man has often been thought of as the man who is always "looking out for Number One," while the good man has been supposed to be the one who is constantly thinking about the interests and highest well-being of his fellow-men.

The distinction is, however, entirely too sharp to correspond with the facts of life and of human nature. It is very seldom, indeed, that I see a human being acting in a way which I should feel justified in pronouncing without qualification egoistic; and it is, if posible, even more rarely that we are confronted with behavior that can be said without any qualification whatsoever to be altruistic. The boundaries between selves are not so sharply defined as they are often supposed to be. In a very real sense, different selves are found to overlap one another. I cannot think of myself without reference to other selves which help to constitute the very warp and woof of "myself"; and, in like manner, those "others" in whom I am interested in my "altruistic" moods are found to be *my* child or *my* wife; *my* parent, brother, or friend; the candidate or leader of *my* political party or faction; *my* neighbor, *my* fellow townsman, *my* fellow human being; etc., etc.

Motives, Intentions, and Ulterior Consequences.—Another point which ought to be considered—or perhaps the same point from a different angle of approach—is the difficulty, not to say impossibility, of determining in any given case of human behavior what the motives of the agent actually were. If, as is suggested by the etymology of the word, a "motive" is under-

stood to be anything whatsoever which *moves* the agent to action, it is necessary to distinguish as clearly as we can between motives, on the one hand, and intentions and ulterior consequences, on the other. "The performance of an act," says Professor Harvey A. Carr,[3] "cannot be legitimately explained in terms of its subsequent effects. We must thus avoid the naïve assumption that the ulterior consequences of an act either motivate that act or serve as its objective." A young child drinks milk which maintains its life and promotes its bodily growth. It would however be a mistake to suppose that the child drank the milk in order to live and grow; for the child knows nothing about the ulterior consequences of its behavior, but drinks because it is hungry. In this case hunger is the motive, and life and growth are the ulterior consequences. In the case of an older person it may be supposed that eating is determined in part by a conscious regard for health and strength. Here the intention of the agent, that is to say, his foreknowledge of the consequences which may reasonably be expected to flow from a given act, becomes one of the motives which produce the act.

It is very difficult, however, to determine the relative importance of such intentions and of the other motives which lead to a given course of behavior. Indeed it is hard to tell in many cases whether there was really any intention at all, or whether the thought of the consequences was wholly *ex post facto*. And in the jargon of contemporary psychology, the reference to consequences which were either not thought of at all when the act was done, or which played a very subordinate rôle in bringing it about, is known as "rationalization." "The human mind," says Carr,[4] "is prone to rationalize its own acts, *i.e.* to assume that they are motivated by an idea of their consequences. A person feels a draft and gets up and closes the window. Upon being questioned as to his motives, he may reply that he closed the window in order to avoid catching cold with its attendant ills, while as a matter of fact any such thought never entered his head until the act was completed." (His real motive, we

[3] *Psychology*, 1925, p. 80. [4] *Ibid.*, p. 81.

may suggest, was the present discomfort produced by the current of air.)

When we say then that an act is altruistic or egoistic, as the case may be, do we mean that it actually benefited the *other* or the agent himself, or do we mean that the agent intended and expected it to produce one or the other kind of benefit? If the former meaning is agreed upon, it is manifest that few acts can be pronounced egoistic or altruistic with any degree of certainty until long after their performance. If the latter meaning is preferred, no one but the agent himself would be in a position to tell whether a given act is egoistic or altruistic; and in view of our human tendency to rationalize our conduct, even his verdict must be admitted to be very untrustworthy.

It must be clear too, in whichever sense we understand our distinction between egoistic and altruistic behavior, that our behavior is seldom *pure*. On the contrary, we usually have many different motives, some of which are egoistic and some altruistic, and the consequences which flow from our behavior are usually beneficial, or detrimental, *both* to ourselves and to others. Furthermore it is important to observe that our interests are frequently impersonal. That is to say, we are interested in things and activities for their own sake. It is possible to argue, indeed, that what we are really seeking is not the thing or the activity itself, but the pleasure of possessing the thing or of engaging in the activity. And this is no doubt true in some cases. But to assert, as is maintained by the psychological hedonist (see p. 388), that in all our activity we are seeking pleasure, is to become too sophisticated.

We may conclude, then, that the distinction between egoism and altruism is neither so clear nor so important as has sometimes been supposed. For much of our behavior is both egoistic and altruistic; and much, on the other hand, is neither. We may add that it is much more important that a man be *intelligent* than that he be altruistic; and that an enlightened egoist is likely to be a more useful member of society than an ignorant altruist. Indeed, the enlightened egoist would probably not be

an egoist at all in the ordinary sense of the term; for with increasing enlightenment he would recognize his solidarity with many of his fellow-men. (See p. 390.)

Instead, then, of preaching that men should be "altruistic," it will be more helpful to lead them to see that each self finds its true realization in its loyalty to the community of selves of which it is a part; and that "self-interest" when sufficiently enlightened will operate as an interest in this community of selves, which by a not too violent figure of speech may be spoken of as *a larger self* that includes each one of us.

4. Democracy and Human Nature

It is the fashion at present among some "advanced" thinkers and critics of contemporary civilization to point the finger of scorn at democracy, although what the critics propose to substitute for it is by no means clear. One wonders whether they would actually return to some form of hereditary monarchy or aristocracy, or whether they contemplate a succession of dictatorships. For the most part, instead of facing the facts of human nature as they are, these critics content themselves with pointing out the defects of democratic governmental arrangements, as if the whole question consisted in a comparison of existing institutions with some ideal condition of affairs.

Into this aspect of the debate we need not enter, except to point out that in any realistic discussion we should compare the merits and demerits of democracy, not with those of some purely ideal scheme, but with those of plans of government that are humanly possible.

One of the standing objections to democracy is the allegation that it depends upon the doctrine that all men are equal, and that this doctrine has been demolished by contemporary psychology. Intelligence tests, it is said, have shown conclusively that men are not "created equal." Now it is quite true that men are found to differ in intelligence, whether native or acquired, as "one star differeth from another star in glory," and that, after these differences have been discovered, it is foolish

and unscientific to treat everybody in exactly the same way. But when the fathers proclaimed in the immortal declaration that "all men are created equal" they themselves were assuredly not unaware of certain inequalities. Men differ in height; they differ in weight; they differ in mechanical skill; they differ in honesty and dependableness; they differ in power of thought and breadth of information. Such differences undoubtedly exist; but inasmuch as the fathers can hardly be supposed to have been unaware of them, inequalities such as these cannot be regarded as negations of the assumption upon which democracy is founded.

For the essence of the democratic principle is not that all men are exactly alike, but that all men are equal before the law. In other words, *all men are to be treated as equal unless and until* they have been shown to be unequal. A special case of this principle is the maxim that a man is to be considered innocent until he has been proved guilty of some specific crime. In the same way every man is regarded as sane unless he has been proved to be insane. Thus, in a democratic régime, the burden of proof rests upon him who says that a given man X is more competent, or less, to pass upon questions of public policy than the rest of us. In an aristocratic régime, the contrary assumption prevails. Because X is the child of certain parents he belongs to a certain class, and therefore possesses certain rights, immunities, dignities, and powers, which differ from those possessed by the members of other classes; and a very heavy burden of proof rests upon anyone who has the temerity to suggest that this man X, because of individual qualities which happen to be his, ought to be accorded rights and powers by nature belonging to some other class than that into which he was born. Thus the king is king because his father was king; and men have a given rank in the various orders of nobility because they are the sons of their fathers.

In short, the democrat admits that men differ; but holds that in practice it is the wisest plan to treat them as equal until some specific reason is found for paying attention to individual

differences. The aristocrat, on the other hand, admits the appearance now and then of a man of lowly birth who has more political intelligence than the scions of nobility, and of well-born men who turn out to be of inferior worth and caliber; but holds, nevertheless, that each of these should be treated as exceptional cases, and that as a rule political power should be determined by birth.

Can the Members of a Governing Caste Be Presumed to Be Superior?—A superficial reading of the laws of heredity favors acceptance of the aristocratic theory. For if we could assume that at some period of past time there occurred a segregation of ability such that all persons ranking above 120 (let us say) on the Terman scale of intelligence were included in the nobility and all below this point in the commonalty, it might then be argued with a high degree of plausibility that membership in the lower orders of society creates a presumption of political incompetency.

Unfortunately for the argument, however, the assumption upon which it is based is contrary to fact. There never was a clear-cut segregation of ability. For, in the first place, the nobility has never been sufficiently numerous to include more than a very small fraction of the high native ability of any given nation; and, in the second place, the nobility has always included many persons whose intelligence was far from high. Indeed, admission to the charmed circle has always depended very largely upon the fortunes of war, upon the favor and caprice of kings, upon attractiveness of face and figure, upon lucky chance of one sort or another.

Moreover, even if this assumption could be granted, even if at some remote time ability had been segregated in the manner suggested above, there would be no reason to believe that this segregation would be permanent. For in estimating the probability that the descendants of a man of genius or of talent will inherit the same order of ability, we must remember that many human traits are transmitted from generation to generation in accordance with the Mendelian laws. Thus su-

perior ability, while apparently more frequent in some families than in others, has a tendency to appear sporadically. The son and grandson of an unusually able man are not always unusually able. The superior ability of the great man results, it would seem, from the accidental convergence of a number of desirable traits; and while these traits may be heritable, in the sense that the "genes" which determine them are present in the germ plasm, they may not be combined again in any one individual for many generations. Whether or not a given family stock would be included in a hereditary governing class would therefore depend, not upon the number of superior minds which it had produced in the preceding thousand years, but rather upon the chance that it should happen, so to speak, to be "in flower" at the time when the division of classes took place.

For example, if such a segregation of ability had taken place in America at the beginning of the nineteenth century, it is not likely that the family of Abraham Lincoln would have been included; while if it had taken place sixty years later, the chances are that it would.

We must remember, too, that at least in Europe the younger children and the illegitimate children of the nobility have tended to be absorbed into the commonalty. Accordingly it comes about in the course of several centuries that almost everyone has noble ancestry.

From all these considerations it follows, then, that the superiority of a governing class, in comparison with the rest of the population, is not likely to be so pronounced as defenders of an aristocratic régime are wont to suppose. While the statistical expectation of superior native ability may be somewhat greater in the case of a hereditary governing class than in that of the general population, the difference is hardly sufficient to justify us in assuming, in advance of any test, that "superior" birth is an index of superior political competence. And in any given generation, superior ability is much less likely to remain undiscovered if each person is judged in accordance with what he

himself is able to accomplish than if each is judged in accordance with the merits or social position of his father.

Can a Governing Class Govern Justly?—There is a sense, indeed, in which all that we have just said is irrelevant. For it is not clear that superior knowledge or intelligence, even granting its existence in a governing class, would fit those who possess it to exercise authority over their fellow-men. If the able man uses his ability to exploit and oppress those who are less able, the rule of the less able might be preferable to that of the aristocrats.

A benevolent monarch is a *rara avis*. An unselfish governing class is a psychological impossibility. It is not necessary to assume that the common people are any more altruistic than the members of an aristocratic governing class. For, human nature being what it is, the very altruism of the aristocrat—directed for the most part, as must necessarily be the case, toward those whom he knows and with whom he is able to sympathize—will make it impossible for him to govern justly. In spite of all his good intentions, he will prefer the interests of his own group to those of the other classes. The same thing is true, of course, of the commoners. Only in their case the group is so numerous as to be almost co-extensive with the entire body politic.

We conclude, therefore, that democracy, the rule of the preponderant majority, is the only method of government which can be trusted in the long run to produce even a rough approximation to justice. For if there must be injustice—as perhaps there must in all human arrangements—it is better that a few should suffer injury rather than many.

5. The Dignity of Matter

One of the charges most frequently urged against our democratic, this-worldly, utilitarian civilization is that it is "materialistic." It is not always clear, however, just what is intended by the accusation. That which is condemned is in some cases an over-emphasis upon merely temporary satisfactions, with the

consequent neglect of values that are more permanent and fruitful. In other cases it is the vulgar tendency to attach too much importance to the size and number of things and to disregard the non-quantitative or not readily measurable aspects of reality. In still other cases, however, the charge of materialism is based upon the assumption that "matter" is evil, and that only immaterial values can be genuinely significant.

The Dualistic Attack upon Matter.—This last conception of "materialism" presupposes a dualistic metaphysics. Matter and spirit are regarded as two *substances,* as two radically different kinds of being, each of which is capable of independent existence. Thus, in the case of the individual human being, matter according to this view is a drag upon the free activity of spirit, a clog from which spirit can hope to be completely free only in another world; or, to change the figure, matter is an opaque partition which separates each finite spirit from the Infinite Spirit. The practical outcome of such ideas is the way of life known as "asceticism." Men and women have believed that there is an inverse relationship between the strength of the body and that of its associated spirit; and have sought, by "mortifying" the body, to ensure the endless life of the spirit. Or their thought has been by fastings and scourgings and vigils to wear thin the partition between themselves and the Infinite, in the hope that they might enter into more perfect fellowship with God.

This dualistic disparagement of the body has, I believe, very few defenders in this athletic age. The sickly little good boy, the anaemic saint, the hero of merely negative perfections—these have few admirers at the present time. We have come to see that bodily health, far from being incompatible with the health of the spirit, is in most cases prerequisite to it.

The Monistic Attack upon Matter.—Nevertheless echoes of the mediæval prejudice against "matter" are still audible, not only in pulpit discourses and other hortatory addresses, but even within the halls of philosophy. Indeed some of the most important movements of modern philosophy have been domin-

ated by the anti-materialistic bias. For, strangely enough, the protest against "materialism" in ethics has usually been coupled with a monistic rather than a dualistic metaphysics. Thus "idealism" in ethics has been reinforced by an appeal to idealism or mentalism in metaphysics, and in some contexts the two "idealisms" seem to be treated as identical.

Plausible as this monistic anti-materialism may seem at first sight, upon closer inquiry it will be found to be a logically untenable because self-contradictory position. Consider for a moment a semi-popular *tour de force* which is not infrequently attempted by some persons who are acquainted with the most recent results of physical inquiry, and who are eager to find "scientific" support for an ancient prejudice. The argument runs in this fashion: "Matter is composed of atoms, and atoms are now found to consist of electrons and protons; but these electrons and protons are not themselves material, being rather manifestations of energy, that is to say of spirit. It follows that what has been called 'matter' is not matter at all, and that whatever really exists is of the nature of mind or spirit. Materialism is accordingly outmoded; and up-to-date science unites with true philosophy in urging us to turn away from the pursuit of material 'goods' and to devote ourselves to the realization of spiritual values."

In short, our interest in material things is to be destroyed or redirected in consequence of the discovery that matter is not really material. One wonders, however, what can be meant by the term "matter" in the proposition, "Matter is not material"! It is as if a military commander should say to his despondent troops, "The enemy is not really hostile; those who have seemed to be enemies are really friends in disguise; let us therefore take courage and go forth to fight—the enemy." If then we are reproached for our pursuit of food, drink, expensive clothing, houses, lands, bank stock, and automobiles, on the ground that these are all but "material" things, unworthy of the attention of spiritual beings like us, we have only to reply that by our critic's own showing these are not material but spiritual. For

if all things are spiritual, then bread, for example, is spiritual; and if bread, and the body which it nourishes, are forms of spirit, then eating must be a spiritual exercise.

Indeed the same inevitable self-contradiction dogs the steps of any monistic attack upon a "materialistic" way of living. To convince yourself that all things are spiritual, or at any rate, immaterial, does not help you in the least. For so-called matter will still remain. In other words, some of your immaterial realities must be admitted to be less desirable than others; and the knowledge that these are all really immaterial gives us no help whatsoever in deciding which of them are better or worse than the others.

It must be admitted, of course, that the widely prevalent tendency to seek present satisfactions at the risk of losing greater future goods is very unfortunate—very wicked, if you prefer; only it ought to be called "immediatism," or simply imprudence, rather than "materialism." Or if the term materialism is employed to denote an over-emphasis upon mere *quantity* of matter, we may agree, again, that this mental habit is worthy of condemnation, while suggesting, as before, that "materialism" is not the most appropriate designation for this vulgar failing. Nothing is gained by mixing up our contempt for the heedless pursuit of present good, or for the vulgar worship of mere size, number, or quantity of things, with a condemnation of matter as such. For matter *as such* is neither good nor evil; it is the necessary condition of both; and if one believes that the world is predominantly good, matter, viewed as instrument, must be good also.

6. The Genuineness of Transitory Values

The preceding section might very well have been headed, "An Extravagance of Philosophy," for it has been the philosopher rather than the plain man who has been inclined to disparage "material" satisfactions. Another extravagance to which many philosophers have been addicted is the condemnation of certain values—of nearly all human values, indeed—on the

ground that they are transitory. This sweeping condemnation of the transitory is a natural inference—but not a logically necessary one—from the obvious truth that permanent goods are preferable, *ceteris paribus,* to those which are evanescent. Permanence, however, is a relative term; and while it is true that the more permanent good is usually better than the less permanent, it does not follow that all genuine values must be absolutely everlasting.

It is highly important, I believe, that those who arrive at their view of the world and of life *by way of the sciences* should avoid the superstition that absolute permanence is a *sine qua non* of value. For contemporary science gives little support to the hope of personal immortality, in the sense of the endless survival of individual selves; and scarcely permits us to envisage an everlasting continuance of the human species. If we should insist, nevertheless, that transitory values are not genuinely valuable, the result of this insistence—in so far as the principle is understood and really accepted—must be an attitude of disillusion and despair, or else a morbid flight from reality to a world of dreams. He who at each stage of his quest of the good rejects proffered values in order to look for something still more permanent, is like the child of the nursery tale who went to seek the gold that was said to be at the end of the rainbow.

The Temporal and the Timeless.—Some very subtle philosophers, however, have condemned both transitory and everlasting values; and have exhorted us to seek a Good which is timeless, that is to say, which is not infected at all with temporal change and process. These philosophers insist that such value as really inheres in temporal flux and change is derived—although it is hard for more tough-minded thinkers to see how this derivation is possible—from the non-temporal and non-successive perfection of the timeless, unchanging Whole.

This seems, indeed, to be the view of Josiah Royce in his *Religious Aspect of Philosophy.* "It is marvelous," says this eminent philosopher, "to behold the religious comfort that, in their shallow optimistic faith, so many amiable people take,

while they wax fervent over the thought of progress. Let us have clear ideas about the matter. What is in the true nature of reality is as eternal as reality itself. Then progress is either an unessential insignificant aspect of reality, or it is eternal. If progress has been eternal, then either the world was in the beginning infinitely bad, or else infinite progress has been unable to remove from the world the finite quantity of evil that was always in it. . . . If you found a man shoveling sand on the seashore, and wheeling it away to make an embankment, and if you began to admire his industry, seeing how considerable a mass of sand he had wheeled away, and how little remained on the sand-hill on which he was working, you might still check yourself to ask him: 'How long, O friend, hast thou been at work?' And if he answered that he had been wheeling away there from all eternity, and was in fact an essential feature of the universe, . . . you would be moved to say: 'So be it, O friend, but thou must then have been from all eternity an infinitely lazy fellow.' Might we not venture to suspect the same," adds Royce, "of our law of universal physical progress?" [5]

But is it really absurd to think of the present state of the universe as a stage in an indefinitely continued creation of good? If we wished to argue the point, we might maintain that an infinite progress—whether or not it is factually probable—is not logically impossible. And we might support this contention—cogently enough, it seems to me—by referring the critic to the analogy of an infinite series of numbers, such as . . . $\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4, 8, 16, 32, . . . which contains an indefinite number of terms, and nevertheless represents a constant increase in value.

From our present point of view, however, this would be an irrelevance. It is more important to insist that even a *finite* process may possess genuine worth. Thus even if it were true, as Royce asserts, that "an infinite series of successive acts cannot be one organic historical process," and that "it is of the

[6] *Religious Aspect of Philosophy*, 1910, pp. 248 f.

essence of an intelligible historical process to have, like a tragedy, in Aristotle's famous account of tragedy a beginning, a middle and an end"; [6] we should still maintain that the values realized in a finite historical process—such, for example, as the career of a good man or the history of a great nation—would be genuinely valuable in spite of their transitoriness. The circumstance that a process does not last forever, or that it does not constitute a completed organic whole, does not make it, or its constituent parts valueless.

The Part and the Whole.—But this, it may be said, is precisely the issue which we are discussing. To some minds it seems to be intuitively certain that the value of the parts is dependent upon that of the whole to which they belong; and if this principle be accepted, it would follow with logical necessity that all genuine value must inhere in the Absolute, that is to say, in an all-embracing Whole. To me, however, the principle is far from evident. There are cases, no doubt, in which the parts derive their value from that of the whole; but there are also cases in which a whole or an aggregate derives its value from that of its parts. A flower or a portrait would be obvious examples of the former relationship; a truckload of baker's loaves, a ten-volume history of the United States, the lifetime of a man, the history of a nation, the temporal span of a solar system, would be examples of the latter.

I am assuming, of course, that there may be parts of reality which are themselves wholes. For if the term "whole" is denied to all aggregates except the one all-embracing Whole, the attribution of value to this Whole is sheer assumption. In order that a whole may be known to possess value in its own right (and not as derivative from the value of its parts) it must not be so large as to be incapable of being immediately apprehended. It is idle, therefore, to say that value inheres primarily in the universe, or in a totality of all existing things; for the universe eludes our grasp, and we cannot be sure that it really is a whole in the strict sense and not merely an aggre-

[6] *Ibid.*, p. 249.

gate. It may be suggested, indeed, that the absolute totality of things is a Mind, and that this Mind apprehends and enjoys itself; but this alleged self-enjoyment of the Absolute is an unverified and unverifiable speculation. From the point of view of a sane *human* philosophy, if the universe is good, or if any historical process is good, its goodness must accordingly be derived from that of its parts, and not *vice versa*. Unless transitory goods are genuine, it is very doubtful, to say the least, whether there are any genuine goods at all.

In avoiding the Scylla of heedless particularism, we need not then run into the Charybdis of absolutism. It is right for men and women to pursue such goods—even if they are partial and transitory—as it is possible for finite denizens of our ephemeral little planet to achieve and enjoy. It is well that religion and philosophy should constantly remind us that the satisfactions of life are often incompatible with one another; and that in pursuing present and evanescent joys we are in danger of losing goods that are greater and more permanent. But religion and philosophy do us an ill turn if they seek to convince us that transitoriness *as such* is evil. "The flower fadeth," but it is beautiful while it lasts; and it is not wisdom, but folly, to allow our knowledge of the flower's eventual destruction to blind us to its present worth.

7. Prestige and the Evidence

The philosopher aspires above all else to be *a thinker;* but for one person who tries to think, there would seem to be a dozen who are looking for readymade opinions which can be supported by the authority of great names. The besetting sin of minds that are capable of reasoning is the tendency to test proffered doctrines—whether in philosophy or in some other department of thought—by the prestige of those who proclaim them rather than by the evidence which can be adduced for or against them.

In all matters of the intellect it is vastly more important that we should ask, "What?" and "Why?" than that we should ask,

"Who?" Merely to assert one's own opinion, in however assured and dictatorial a manner, or merely to quote, however learnedly, the opinions of others, does not make one a great thinker. Neither does one become an independent thinker merely by holding views contrary to those which are commonly accepted. Whether we agree or disagree with those who are regarded as "authorities" in a given field is a matter of slight importance; but it is a matter of very great importance that we should be able to state all views fairly, and to base our agreements, disagreements, or suspensions of judgment upon cogent reasons rather than upon authority.

It is not enough that we should know what the great man thinks about any given question; we also wish to know what reasons he is able to give for the conclusion to which he has come.

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